Heating Piping & Air Conditioning

FEBRUARY 1960

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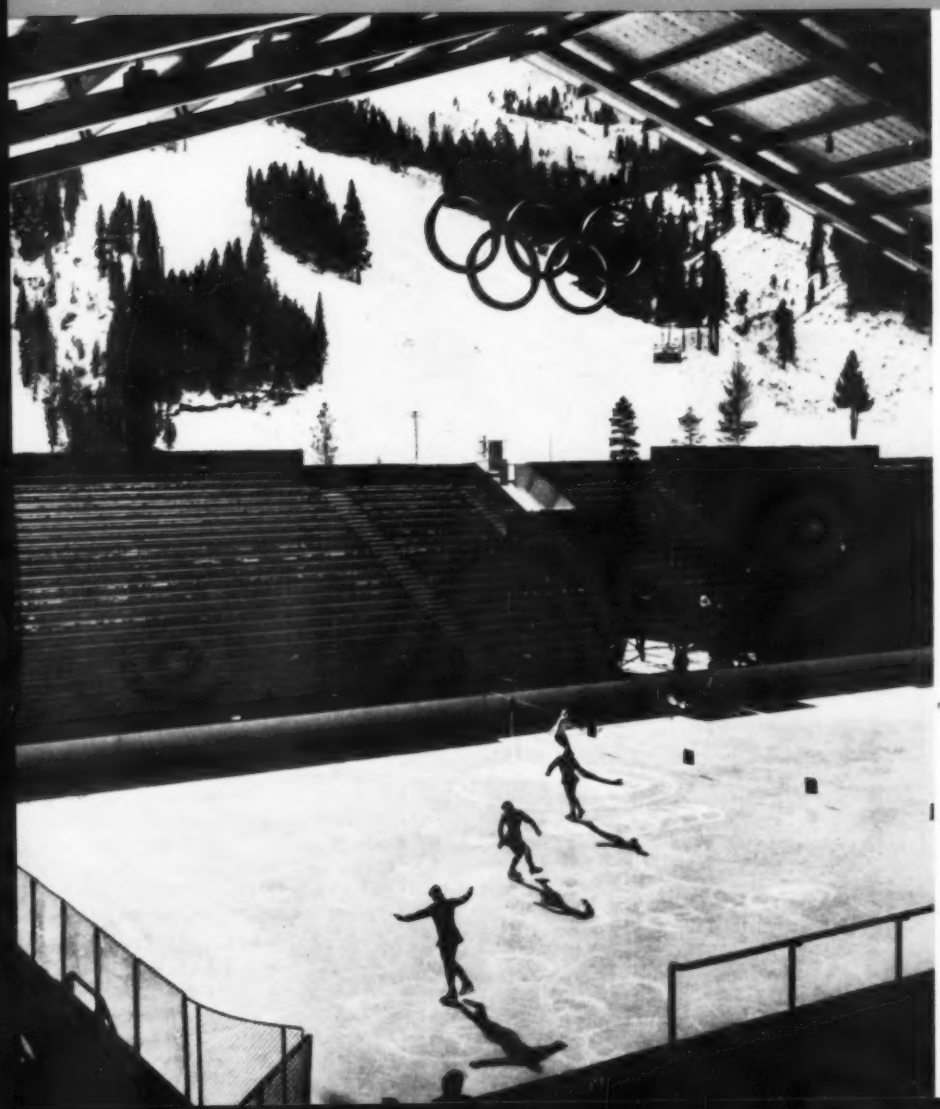

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Heat pump will deliver heat removed from ice rink refrigeration system to warm spectators, melt snow at Olympic Winter Games at Squaw Valley this month

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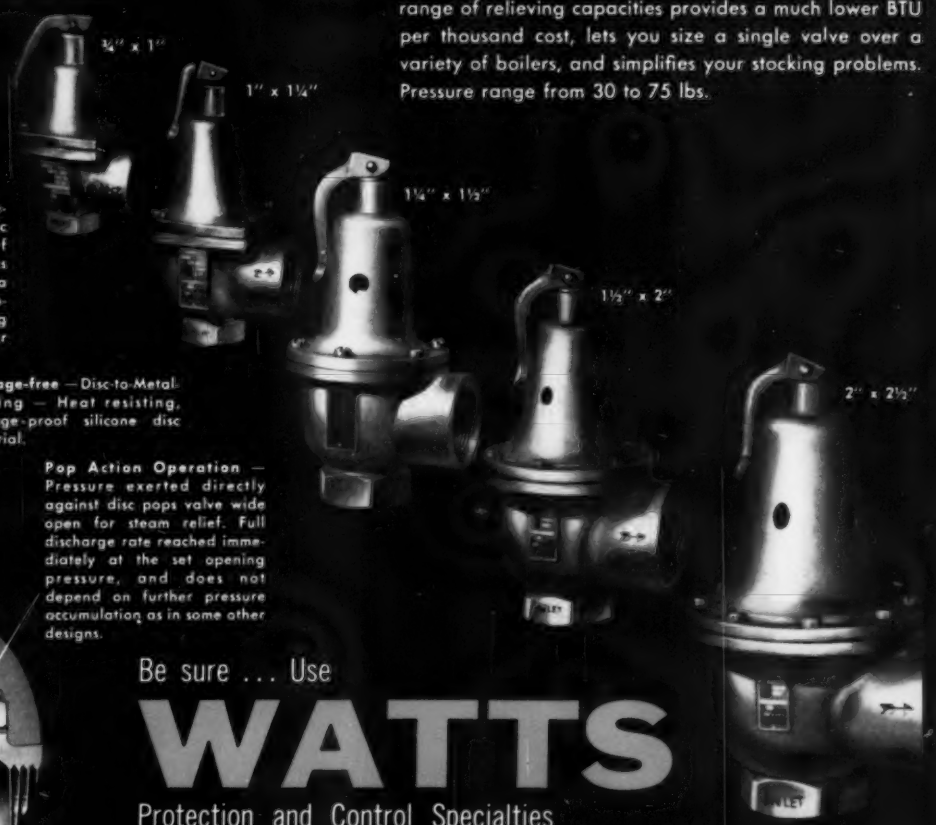
MOST COMPLETE LINE OF ASME PRESSURE RELIEF VALVES

NO. 740 SERIES FOR HOT WATER SPACE HEATING BOILERS

Full selection of high capacity valves provides low cost protection

Watts No. 740 Series are especially designed for hot water space heating boilers. They have extremely high discharge capacities because of their large internal flow areas . . . making them the ideal, economical choice for boilers which previously required larger size valves for adequate protection. The ¾" size, for example, rated at 895,000 BTU/HR at 30 lbs., approximates and in some cases exceeds the ratings of many 1" valves. This wide range of relieving capacities provides a much lower BTU per thousand cost, lets you size a single valve over a variety of boilers, and simplifies your stocking problems. Pressure range from 30 to 75 lbs.



Water Seal — Provides precise alignment of sent to disc and eliminates need of hazardous mechanical guides which can stick or freeze a valve shut from lime or corrosion. Seal also protects spring working parts from water or steam during relief.

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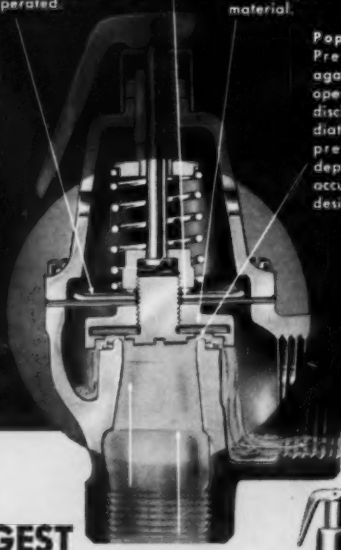

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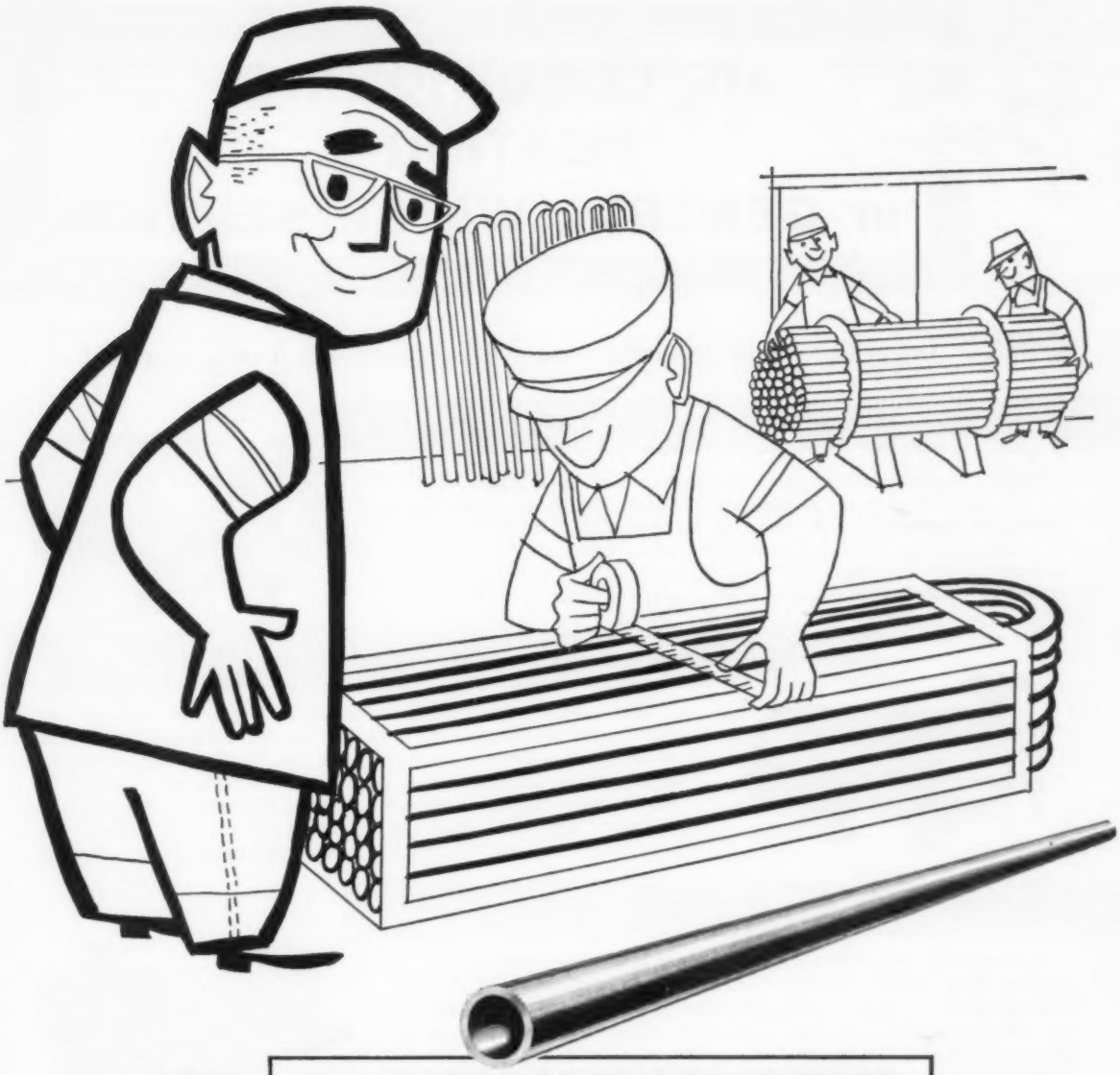

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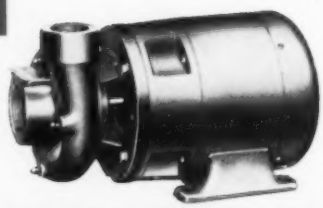

These off-the-shelf Motorpumps are built in sizes from ⅓ through 25 horsepower to suit any condition to 775 gpm with heads to 190 ft. Advanced engineering and exacting manufacturing have produced these Motorpumps which handle liquids from −30°F to 211°F. Easily hooked up, they are ideal for air conditioning, heating or general water service. They are furnished in screwed connections from ¾" to 3".

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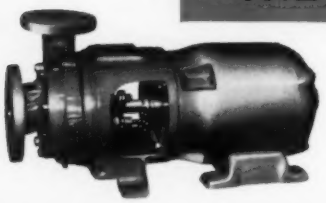

The class RV Motorpumps are made as single, two or four stage units available with screwed or flanged connections from 1" to 6". The extra-heavy construction with oversize shaft and bearings assure the maximum in dependability and performance. Built in 1 through 75 hp size these rugged units can deliver up to 3200 gpm . . . heads extend to 650 ft. This Motorpump line is well-suited for large air conditioning installations, heating (to 250°F), boiler feed or general water service.

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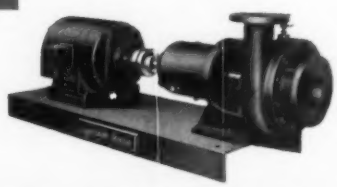
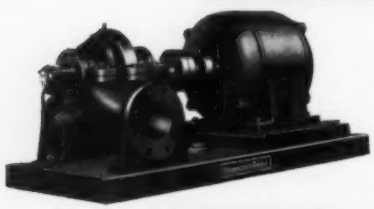
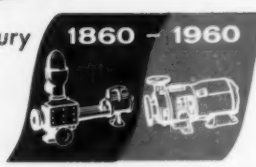


HORIZONTALLY SPLIT LINE OF PUMPS



Here's a really complete line of single or two stage, double-suction pumps for such service as cooling water circulation in condensers, cooling tower systems, air conditioning equipment, drinking water supply, heating, etc. Built in 1½ through 10 inch discharge sizes, deliveries range to 4000 gpm and heads extend to 1100 ft. Horsepowers range to 400 and liquids can be handled to 400°F.

a century 1860 – 1960 *of pump progress*



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Heating, Piping & Air Conditioning

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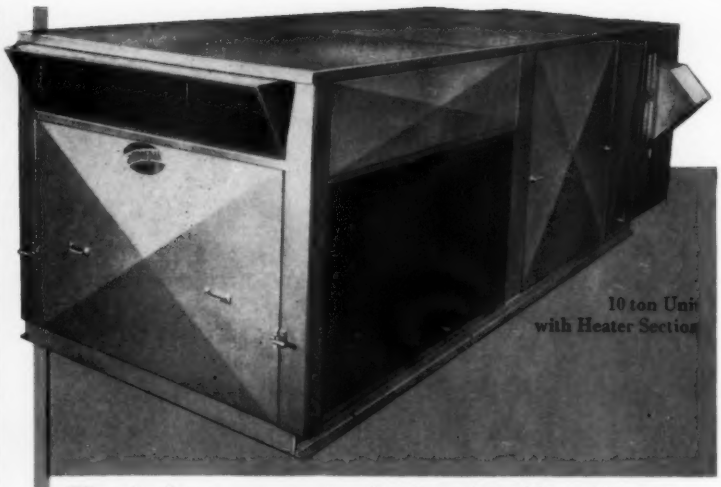

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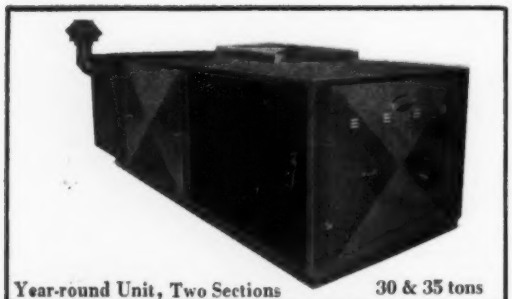

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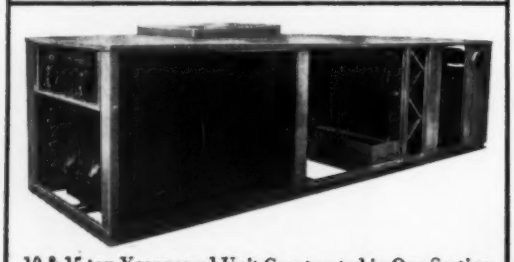

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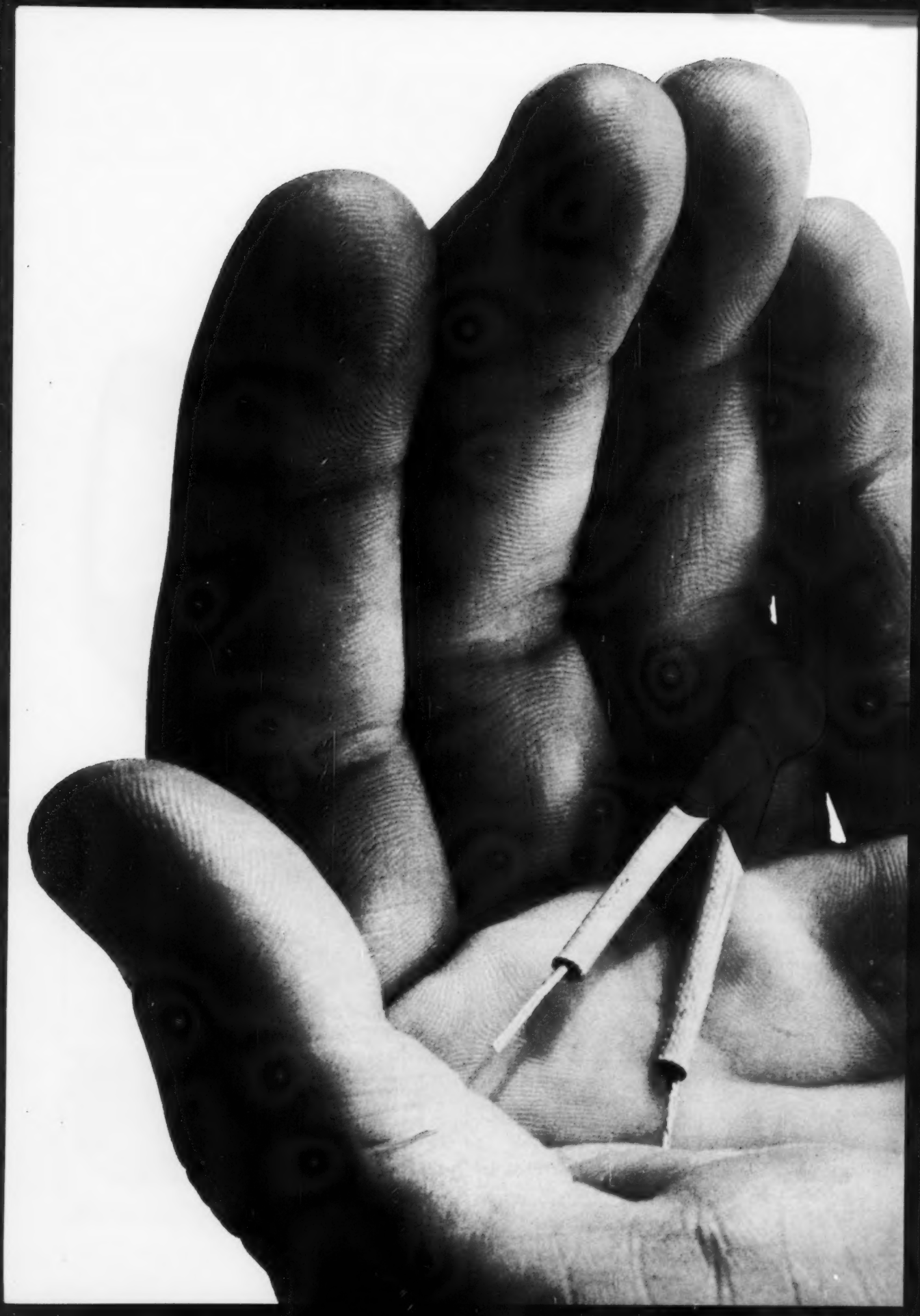

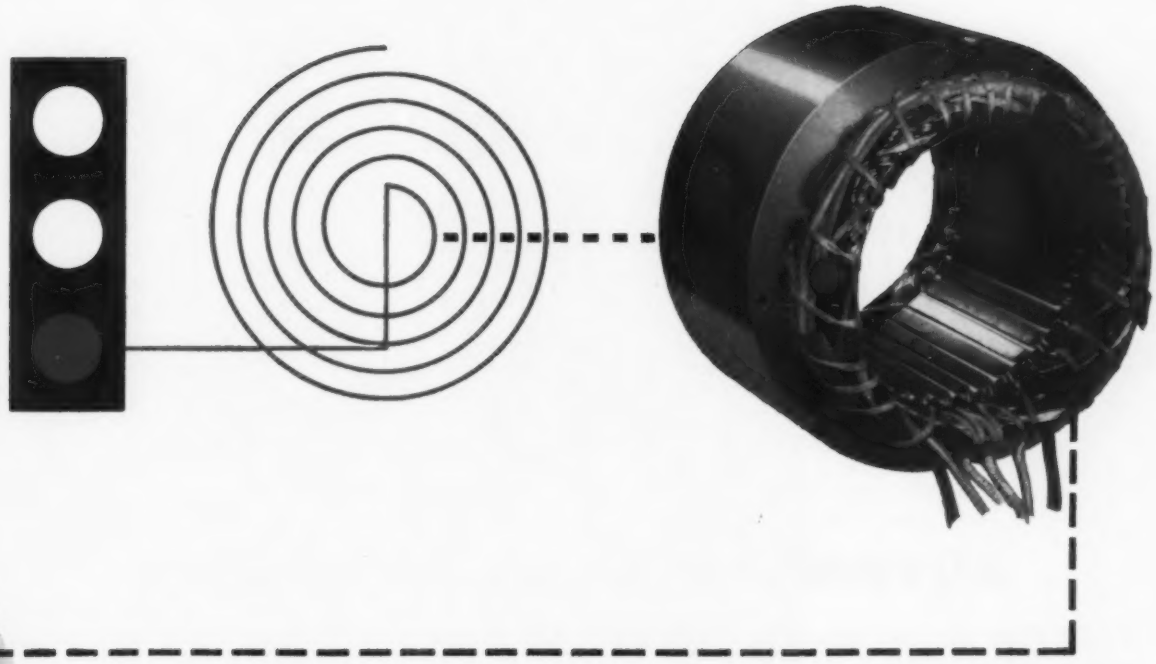

New Westinghouse *Guardistor* motor stops motor failure caused by excess heat

At last, positive protection against motor overheating with this unique Westinghouse motor development. Smaller than an aspirin, the heart of the Guardistor* motor is a PTC† Thermistor embedded in the motor windings to sense temperature rise immediately.

With normal motor temperatures, the thermistor has low resistance which remains nearly constant up to a predetermined critical temperature. At this temperature, a 100 to 1 or more increase in resistance occurs for a small increase in temperature. The resistance stops current flow activating a control designed to "WARN" or "STOP" a motor failure.

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LETTER FROM THE EDITOR

February 1960

Dear Reader:

The new Olympic Ice Rink at Squaw Valley in California will be the focal point of much interest later this month when the 1960 Olympic Winter Games open. Dan Vandament of the consulting engineering firm of Vandament & Darmsted explains some of the background and reasoning behind the decisions to design the heating and piping systems for this new facility in his article which begins on page 99. Many novel ideas have been employed which will be of interest to you, I am sure.

Air cooled condensers are discussed this month by Lester T. Avery in his article on page 103 in which he points out that too many fins can "bottle-neck" heat transfer.

How to design suction piping and deaerator storage capacity to protect boiler feed pumps is explained by Rodney S. Thurston on pages 104 to 107. In this article he presents an analytical method for determining the minimum permissible weight of water ratio between the deaerator storage tank and the suction piping to the boiler feed pump. With sufficient capacity, this tank is capable of insuring against flashing at the pump's suction, thereby avoiding cavitation and vapor binding of the pump. He gives five steps that should be followed in determining the deaerator storage capacity and an example showing how to calculate the minimum storage capacity.

The new sheet metal duct manual recently made available through the Sheet Metal and Air Conditioning Contractors National Association contains a suggested specification which is discussed by James H. Stiggleman in his article on pages 108 to 110. In his article, Mr. Stiggleman suggests some of the ways in which this suggested specification can be used and emphasizes the need to be specific about the type of duct construction to be used. He also suggests some ways in which the suggested specification can be improved.

It was decided to install complete air conditioning in the new Naval Guided Missile School at Dam Neck, Va., primarily because the school is operated all year. To further justify the cost, however, Weather Bureau data for the area was applied to the four "zones" established by the Bureau of Yards and Docks to determine the method of providing the desired comfort. These four zones take into account the number of hours of maximum wet bulb and dry bulb temperature experienced during the six warmest months of the year and the type of area that is to be cooled. The systems in this new school were installed at a cost of about $775 per ton of cooling capacity. The analysis of the situation and what was done in this case is explained by Denard L. Gusler in his article on pages 111 to 113.

Careful consideration of all factors influencing cost is necessary when selecting either gas, oil, or coal heating systems. Such an analysis is mandatory if the plant is to provide optimum performance at the most economical fuel cost. Charles Rand Steele presents a detailed analysis of the fuel selection problem in his article on pages 114 to 117. He gives five basic rules to follow in order to achieve the right answer and these are worth remembering.

The close temperature, air cleanliness, and humidity tolerances required in the development and manufacture of nuclear fuel elements demanded several solutions in the design of the systems for the new Combustion Engineering nuclear center. D. M. Collins explains what factors were considered and how the systems were designed to achieve the desired results in his article on pages 118 to 120.

The HPAC Data Sheet this month is on pages 123 and 124, and it explains how to size gravity roof vents by means of a nomograph. Several examples are also included.

Modernizing existing office buildings by adding air conditioning continues to offer some interesting problems and solutions. Such is the case of the installation of air cooled, self-contained units in the Century building in Milwaukee. Meeting all the requirements of construction, timing from the tenant's standpoint, and water availability, it was decided to use a number of 7½ and 10 ton units. Three different applications are discussed in the article on pages 126 and 127, which may be applied in other modernization projects.

The design and installation of piping systems for cryogenics are not basically different from those for the more familiar fluids. However, some differences must be considered because of the lower temperatures encountered. The field of cryogenics pertains to liquefied gases in the temperature range from −250 to −460 F, and in the last 10 years this field has grown to be a multi-million dollar industry. Applications for liquefied gases today are branching into the missile and rocket propulsion areas, thermonuclear power plants, transportation of natural gas, and many others. The properties of the piping materials can be radically different at these low temperatures. Also, insulation requirements are quite different. What is involved in the design of these piping systems is presented as the HPAC Engineering Data File on pages 129 to 140 and has been prepared by Dr. Robert B. Jacobs of the National Bureau of Standards' Cryogenic Engineering Laboratory.

What's the Best Way to Join High Velocity Ducts? is the Question of the Month and is answered on pages 88, 90, and 92. In one answer, E. M. Schmidt, gives the specifications for one installation and he reports that his solution to this problem has worked out very well in practice. He includes 12 suggestions to follow.

Sam Lewis this month relates his experiences with an oil piping system on page 121. "Open for Discussion" is on pages 83 to 86, and The Law and Your Profits is on page 128. Don't miss the You'll Want to Know news items on pages 41 to46.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

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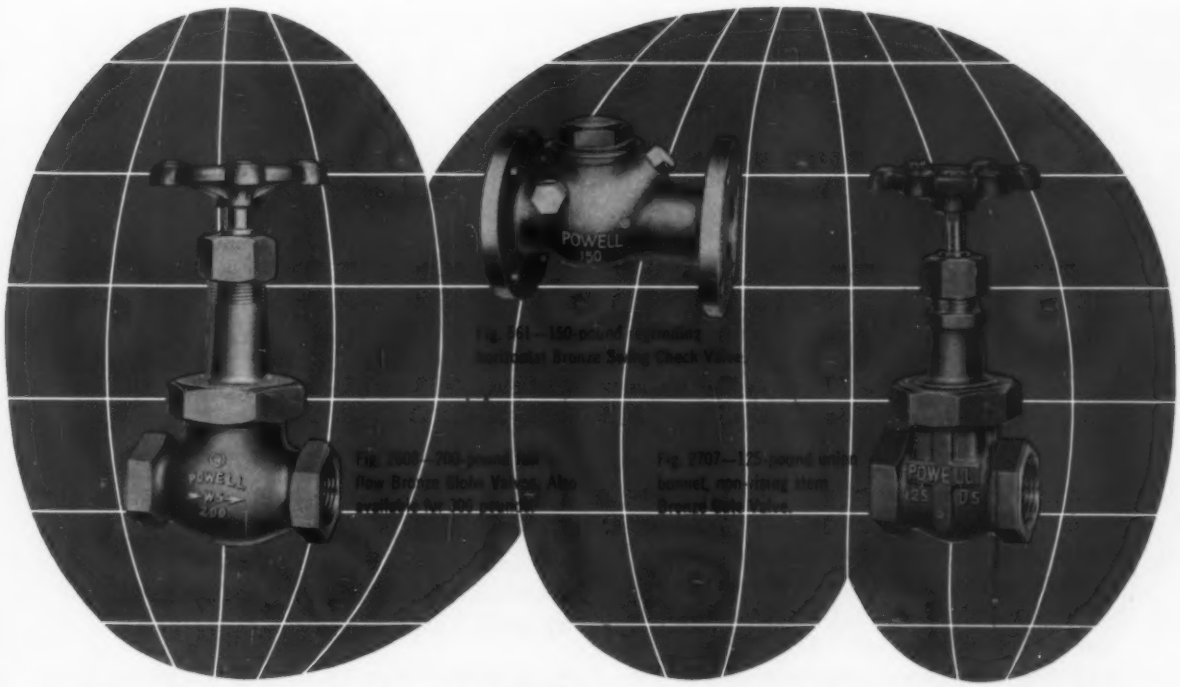

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"Even this huge heat pump went smoothly with

Mr. Frank Flick, President, Flick-Reedy, and Mr. Zay Smith of Zay Smith and Associates; Architects and Engineers, LaGrange, Illinois.

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Honeywell men on the job!"

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Honeywell Engineers working on the air conditioning system at the distinctive new Flick-Reedy power cylinder plant, installed the exact control system needed for one of the world's largest heat pumps!

"The job of harnessing this huge heat pump was mighty important to us," says Mr. Flick. "Our plans called for a customized temperature control system which would assure the welfare of our employees, and solve certain critical production problems. It was a large order, but Honeywell Engineers, working with the York people and Zay Smith and Associates Engineers, solved the problem to our complete satisfaction."

Air conditioning this 220,000 square foot plant presented some unusual problems. The entire work area is fully air conditioned—including the welding, heat treat and plating areas. And, the entire system is completely automatic. A Honeywell Supervisory DataCenter* (shown in background) monitors the heat pump and controls temperatures in every zone.

In addition, every private office and conference room is equipped with its own Honeywell Round thermostat.

As the leader in temperature control for 75 years, Honeywell is well equipped to help you solve your clients' most critical temperature control problems. Call your nearest Honeywell office today. Or, write Minneapolis-Honeywell, Minneapolis 8, Minn.

**Trademark*

Honeywell

H HONEYWELL *First in Control*

SINCE 1885

75th YEAR PIONEERING THE FUTURE

LAU

SERIES A
22", 25" and 30"

DESIGNED FOR COMMERCIAL INSTALLATIONS

Built-in flexibility makes the Lau "Series A" the number one choice for commercial and industrial installations. With a C.F.M. range of from 8,000 to 36,000, this efficient unit may be used in many different sizes and types of air conditioning systems. For even greater C.F.M. capacity and flexibility the "Series A" may be operated in banks of two or three.

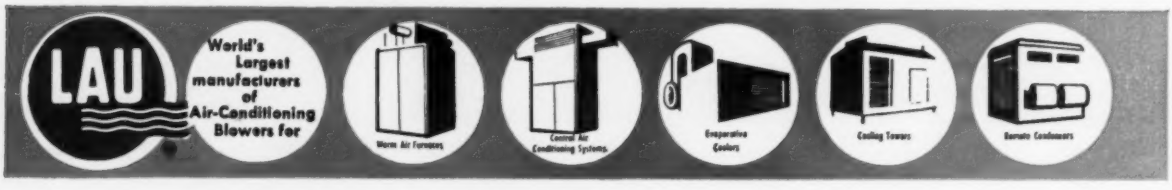
The "Series A" features such quality Lau parts as heavy gauge riveted wheels, large reservoir oil type bearings and sturdy angle framing for housing supports and structural strength. "Series A" blowers provide for either top or rear mounting motor.

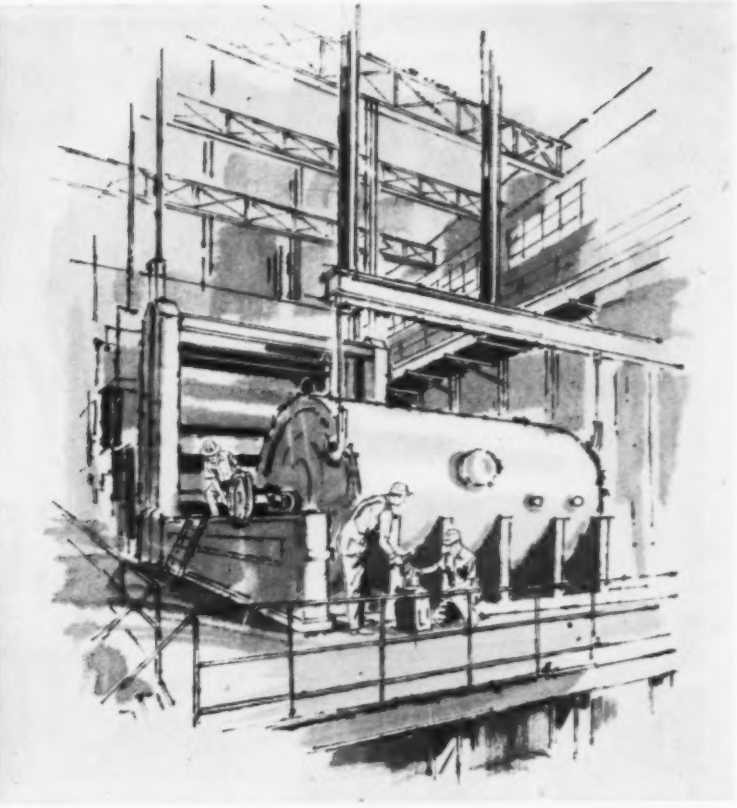
Call or write Lau today for more complete and detailed information.

MEMBER INDOOR COMFORT

The Lau Blower Company, 2027 Home Avenue, Dayton 7, Ohio.

Other plants in Kitchener, Ont., Can., and Irwindale, Calif.





Put your best filter forward and watch your business grow!

Things start happening—*fast*—when you install your first PLIOTRON super-filter.

For it doesn't take a user long to discover that he's getting far cleaner air than ever before. After all, he's using a filter that traps up to *5 times as much of the "untrappable" fine dirt* as an ordinary filter.

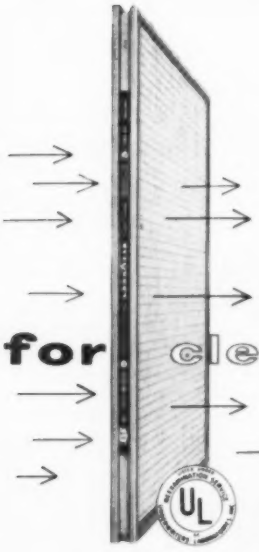
It's not long, either, before he's telling friends and associates about his great new filter "discovery"—and the installer who made it possible.

But it doesn't stop there. In a matter of months, your customer also finds out how much simpler PLIOTRON maintenance is. Instead of a messy, time-consuming re-oiling job, a simple vacuum cleaning or water-rinse restores full filter power.

In time, a PLIOTRON user also sees for himself that these filters aren't just called "permanent"—they *are* permanent. Properly maintained, they're good for the life of the heating or air conditioning system.

That means a PLIOTRON installation keeps advertising you and your business for years. Word gets around that you're the man to see for top-drawer products and services. And that's a reputation that pays off over and over again.

Remember, too—you can install the advanced PLIOTRON CR Filter in most commercial locations—or the new PLIOTRON HD Filter in the most critical industrial installations requiring heavy duty filtering. For complete details, write Goodyear, P.O. Box 52, Akron, Ohio.



for cleaner air everywhere-

NEW PLIOTRON AIR FILTERS BY

GOODYEAR

THE GREATEST NAME IN RUBBER

Pliotron—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

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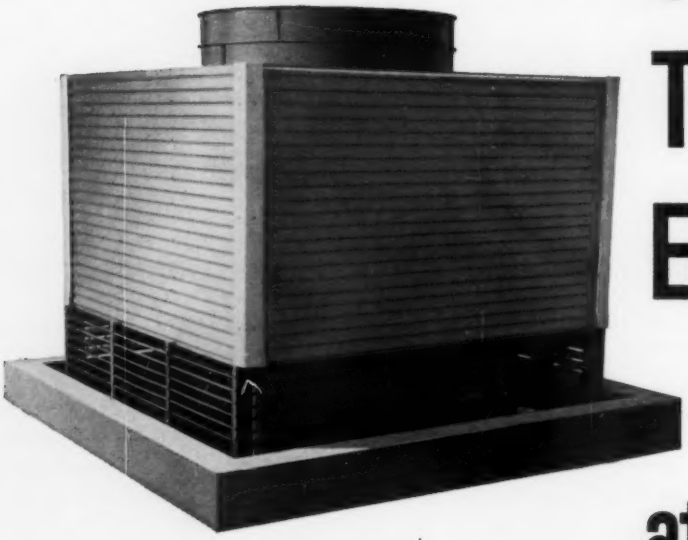
* Since 1919 Fluor has been building cooling towers throughout the world. (An average of one new industrial or commercial cooling tower is erected by Fluor every three days.)



Ask for our brochure that shows why Fluor Towers mean more efficient operation.

Fluor PRODUCTS COMPANY

AIR CONDITIONING AND REFRIGERATION COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
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NEW "BUFFALO" AIR-COOLED CONDENSERS OFFER TROUBLE-FREE OPERATION

Troubles common to most air-cooled condensers are positively eliminated by these field-tested new "Buffalo" units.

"Buffalo" Air-Cooled Condensers are a sound engineering choice for your "problem" air conditioning installations. They are ideal for overcoming such conditions as weight and erection difficulties—high maintenance costs—winter freezing troubles—winter head pressure problems — water shortages — contaminated water — high water cost—high sewer tax—poor drainage.

"Buffalo" Air-Cooled Condensers offer these and many more advantages for air conditioning applications. For full details, call your nearby "Buffalo" engineering representative. Or write us direct.

Easy-to-Install! Shipped as factory-assembled "packages." Lifting eyebolts simplify rigging.

Trouble-Free Operation! Service calls are practically nil, thanks to quality construction and unique control design.

Capacities: 7½ to 100 tons based on 120° condensing temperature, 40° suction, 100° ambient.

Vertical Discharge is unaffected by wind velocity. Holds compressor on line.

Opposed Blade By-Pass Damper Control provides close modulating control not possible with parallel-blade dampers...or with "flooded coil control." Also saves expensive Freon.

Low Silhouette! The No. 1000 unit is only 76" high.

Unit Casings! Heavy-gauge galvanized steel construction for durable long life.

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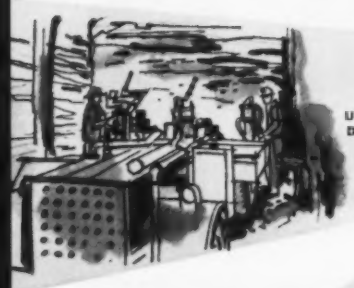

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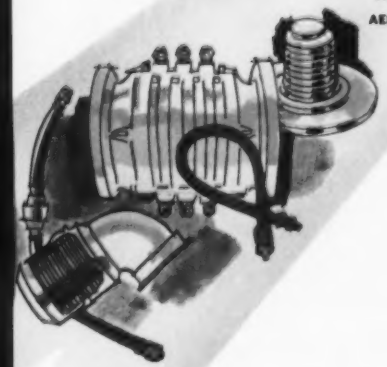


Flexonics joins a famous family

. . . to bring you better products and services

Flexonics Corporation's new affiliation with Calumet & Hecla, Inc., marks another important forward step.

Over its fifty-year history, Flexonics has become a major factor in the precision forming of thin metals—in the manufacture of metal hose, metallic bellows, expansion joints, hydraulic hose assemblies, automotive parts, aircraft and missile ducting systems—virtually everything for combined motion and fluid flow.

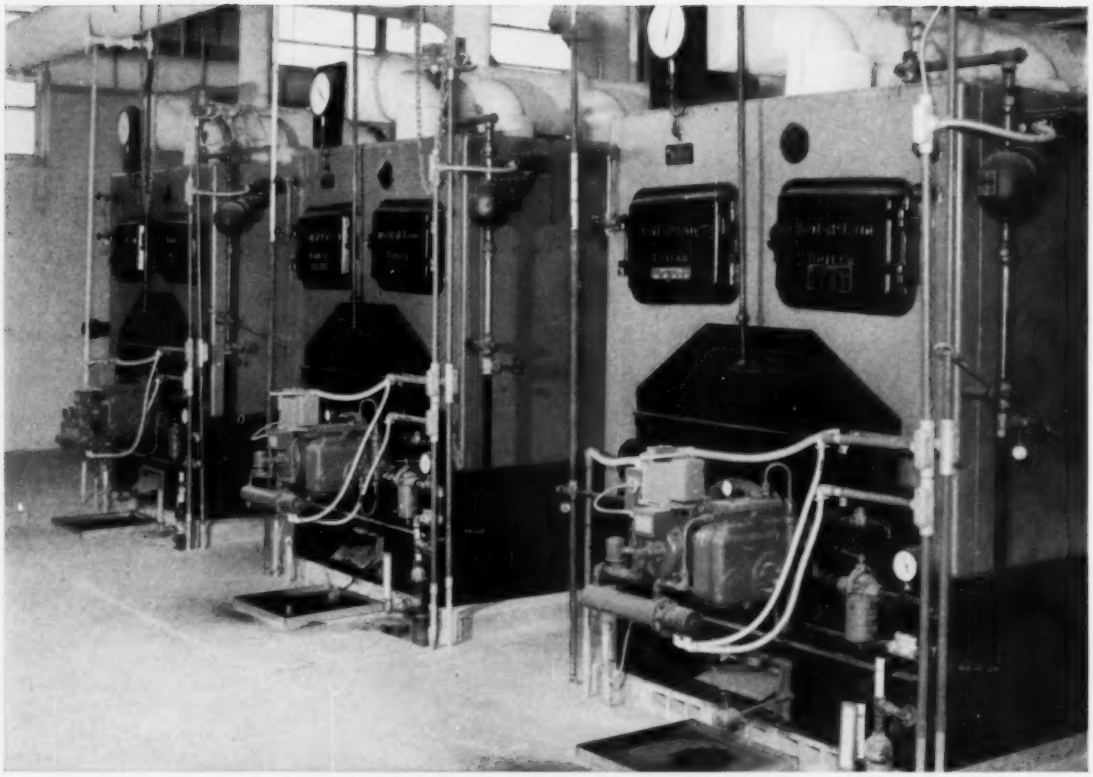
Calumet & Hecla now brings its broad industrial base to Flexonics technology. To industry, this means that new research and development facilities, new production capabilities, will soon be bringing you even better Flexonics products, an even wider range of Flexonics services.

The entire Flexonics organization is looking forward to serving you better . . . in more ways.

Flexonics corporation

1391 South Third Avenue, Maywood, Illinois

a subsidiary of **Calumet & Hecla, Inc.**



SISTERS OF MERCY CONVENT SELECTS

WEIL-McLAIN "HR"

CAST IRON HEAVY DUTY BOILERS FOR HORIZONTAL ROTARY OIL BURNERS

General Motherhouse, Sisters of Mercy of the Union, Bethesda, Maryland

ARCHITECTS-ENGINEERS: Maguolo and Quick, Baltimore, Md.

MECHANICAL ENGINEER: William U. Thompson, Baltimore, Md.

CONTRACTOR: Harry E. Nau & Co., Baltimore, Md.

DISTRIBUTOR: United Plumbing & Heating Supply Co., Washington, D.C.

The three Weil-McLain "HR" Boilers illustrated here develop a total of 315 HP and are designed specifically to achieve the economies possible with horizontal rotary oil burners using low-cost heavy oils. Among the many features which dictated their selection are:

1. Steel front plate simplifies installation of rotary burner.
2. High base makes more combustion space available —eliminates high brick foundation.
3. Large firebox volume develops better combustion conditions and maximum radiant heat transmission.
4. Curved primary heating surface extends from crown sheet, greatly increasing area directly above fire.
5. Balanced gas travel through the flueways assures equal distribution of heat to all secondary heating surfaces.
6. Generous waterways permit rapid water circulation.
7. Large steam space assures rapid generation of dry steam.
8. Rugged cast iron construction for durability.
9. Individual short draw rods simplify assembly and contribute to longer boiler life.

Send for Bulletin C-188. For other Weil-McLain Gas and Oil Boilers, see Engineers' Product File or Sweet's Architectural File.

WEIL-McLAIN
BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

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A.S.M.E. CODE

When you install a B&G Heat Exchanger, you have assured yourself of not only high efficiency, but highest quality construction.

With each B&G Exchanger, a Manufacturer's Data Report for Unfired Pressure Vessels, Form No. U-1, as required by the provision of the A.S.M.E. Code rules, is furnished. This form is signed by a qualified inspector, holding a National Board Commission, certifying that construction conforms to the latest A.S.M.E. Code for unfired pressure vessels. The A.S.M.E. "U" symbol is stamped on each exchanger.

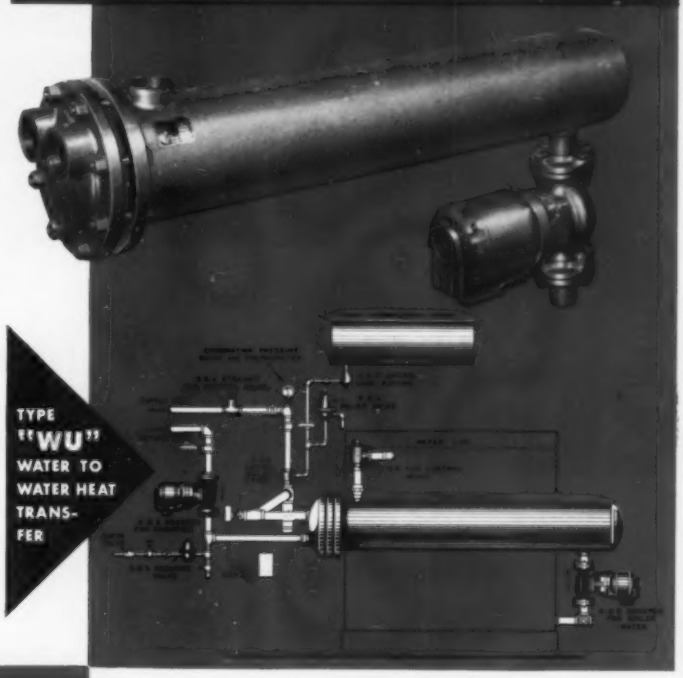
TYPE "WU"

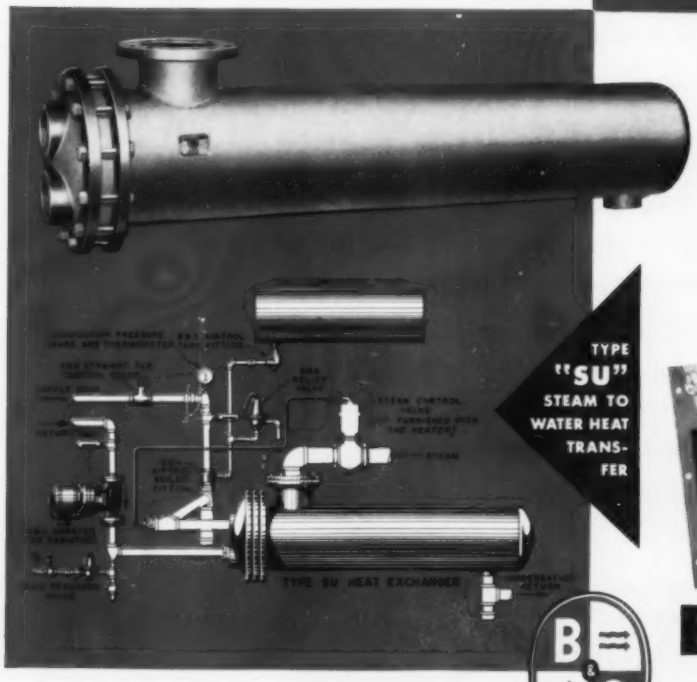
The "WU" Exchanger is equipped with a B&G Booster which pumps boiler water through the shell, greatly increasing the capacity of the unit. An unbelievably small "WU" produces large volumes of hot water. Water temperature is closely controlled... the Booster starts whenever the water goes below the desired degree and continues to run until the water is again at the proper temperature.

When used as a service water heater, a storage tank can be eliminated, because the "WU" heats water as rapidly as it is used.

Heat Exchangers

FOR RADIATION AND WATER HEATING





TYPE "SU"

In buildings where steam is required for process use, the advantages of a forced hot water heating system can be obtained by installing an "SU" Exchanger instead of an extra boiler.

This exchanger also provides an efficient, low cost method of heating water for apartments, hotels, hospitals, industrial and processing plants. No storage tank is needed.

For complete information send for "WU" Catalog No. GC-1054 and "SU" Catalogs No. SC-159 and SI-159.

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Dept. GB-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

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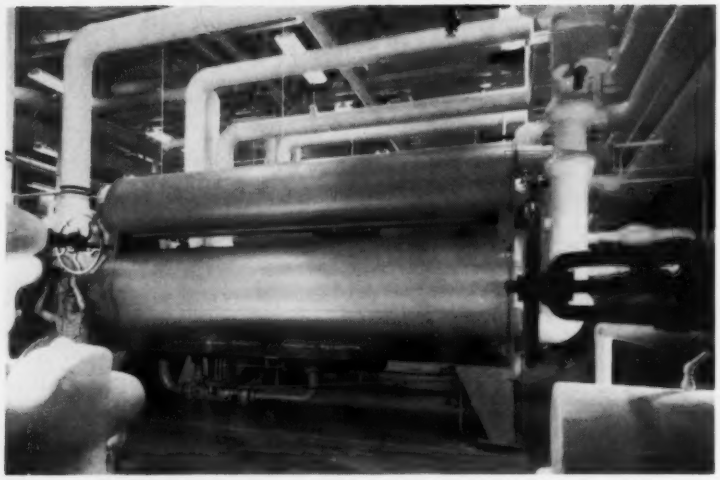

Push-button starting

Automatic STOP-and-GO

Time clock operation

Thermostatic control

First with 1000-ton Capacity . . .
Carrier Absorption Refrigeration!

Fourteen years ago Carrier was first to bring the advantages of this remarkable machine that cools with low-pressure steam or hot water. Now Carrier is first again to offer an Automatic Absorption Refrigerating Machine that is big enough to handle the air conditioning loads of office buildings, hospitals, hotels, department stores and industrial plants with a single unit.

Today more than 1500 of these machines, ranging in size from 50 to 1000 tons capacity, are delivering dependable, low-cost refrigeration. This record is without equal in the industry. So you protect the investment of your clients when you specify Carrier, built by the people who know absorption refrigeration best.

Carrier offers a complete line of components to match the requirements of any refrigeration or air conditioning problem. For information, write the Machinery and Systems Division, Carrier Corporation, Syracuse, New York. In Canada: Carrier Engineering Ltd., Toronto.

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BETTER AIR CONDITIONING FOR EVERYBODY *EVERYWHERE*

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SPORLAN Famous Firsts...

...for Peak Performance Air Conditioning!

Sporlan *Catch-All*... the first molded porous core filter drier... Sporlan's amazing *See-All* the first combination moisture and liquid indicator... Sporlan Solenoid Valves with the layer wound Blue Seal Coil... Sporlan Thermostatic Expansion Valves with the original *FLOW MASTER* element and Refrigerant Distributors with the versatile interchangeable nozzle...

offer ***You*** *a perfect combination engineered to fit any size installation... right down the line!*

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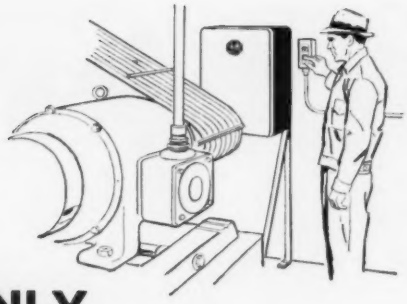
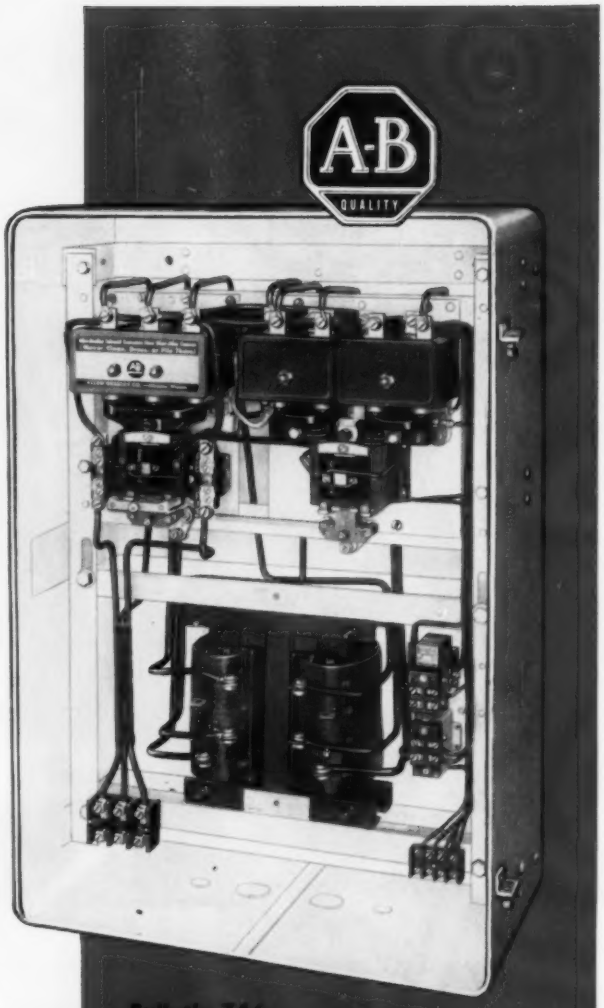


ONLY ALLEN-BRADLEY CAN PROVIDE ALL THE ANSWERS

—for reduced voltage starting of heavily loaded compressor motors

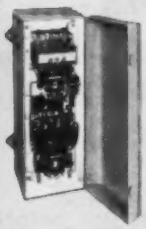
The broad line of Allen-Bradley reduced voltage starters makes possible a selection of the best starter for any air conditioning system—not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the compressor.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088.



Bulletin 746

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

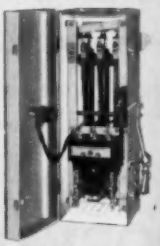


Bulletin 740

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

Bulletin 640

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



ALLEN-BRADLEY

Member of NEMA

Quality Motor Control

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.
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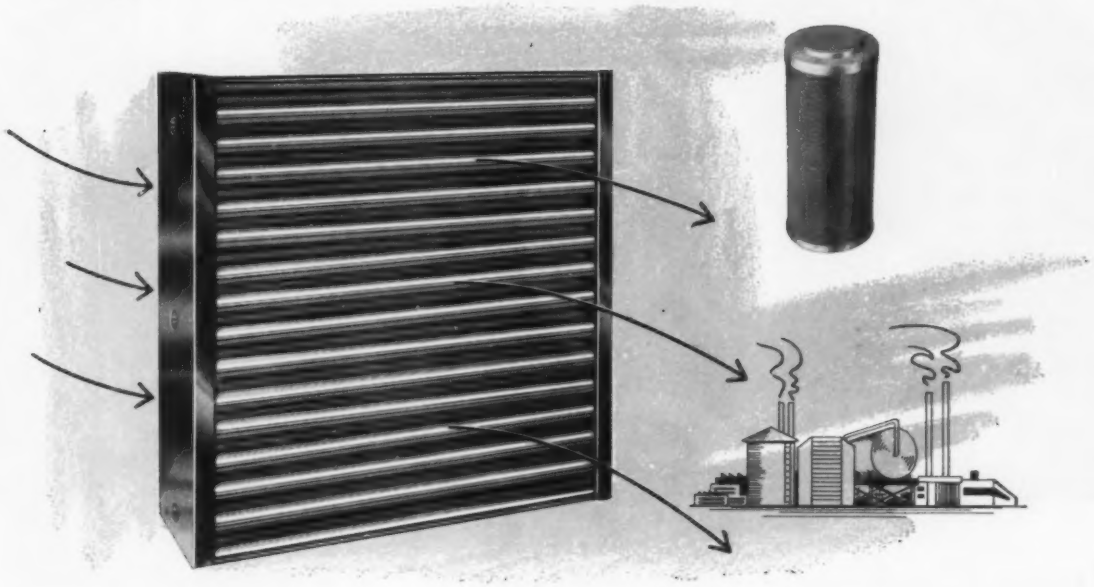
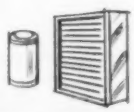
this is DOREX



27 years of Research, Development, and Application make it the most effective, economical method of AIR RECOVERY and ODOR CONTROL

WHAT DOREX IS . . .



Dorex equipment is designed in two basic types—C Cells and H Canisters—Dorex acts exactly like a gas mask, using activated carbon to adsorb air-entrained odorous, gaseous, and vaporous irritants and impurities. As a direct result of the carbon's highly effective purging action, stale and/or contaminated air is purified and reconverted to its original healthful freshness, ready for sanitary re-use in air conditioning systems. The Dorex process eliminates the biggest obstruction to maximum economy in air conditioning.

HOW DOREX WORKS . . .

Dorex efficiently solves the several air pollution problems menacing business, industry, and the general public: purification of severely contaminated intake air (smog); purification of recirculated air; purification of contaminated exhaust air.

WHERE DOREX IS USED . . .

Dorex is used throughout business and industry, in combination with air conditioning and ventilating systems . . . in office buildings, department stores, food processing plants, distilleries, electrical and electronics plants, atomic energy labs, paper factories . . . virtually anywhere that polluted air creates severe problems of offensive odor, equipment corrosion, and toxic atmospheric conditions.

WHY DOREX IS THE MOST EFFECTIVE

Dorex engineers always select the type of carbon that years of Connor research and experience have proved is most successful in different given situations. There is *no single all-purpose* type of activated carbon that can be applied successfully in all air recovery and air purification situations.

CONNOR... for Constant Comfort Conditions

Request—on your letterhead, please—copies of Dorex Bulletin 108A and the authoritative air purification textbook available only from Connor, "Air Conservation Engineering".

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air recovery

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NO OTHER AIR CONDITIONER OFFERS SO MANY IMPORTANT SAVINGS BOTH NOW AND LATER!

York Embassy

SAVE...the expensive installation costs that *run up* the bid! York Packaged Air Conditioners are easily installed without extensive overhauling of the building! They may even be used without ductwork if desired.

SAVE...by quoting on a pay as you go basis! The important areas can be air conditioned first and additional units added as budget permits. This permits a rock-bottom base quotation that would be vital on many jobs.

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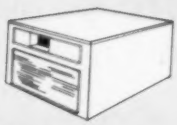
There's no interruption of business or loss of operating revenue, either, with York Packaged Units. And individual units can be turned off when not in use, to cut operating costs even more! Write today for full details!

THERE'S A YORK AIR CONDITIONER TO FIT EVERY INSTALLATION NEED!

YORK Champion
Air-cooled! Remote!
Up to 15 Ton capacity.



YORK Pathfinder
Self-contained! Air-cooled!
Up to 4 Ton capacity!

York Puts More Into Every Unit, So You Get More Out of It.

All Units Backed by Blue Chip Pledge of Performance

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MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice-Making Equipment • Products for Home, Commercial and Industrial Installations

Wagner Vertical Solid Shaft Motors...

POWER PACKED PUMP DRIVES

Got pump-power problems? You can solve them—simply, easily—with Wagner Vertical Solid Shaft Polyphase Motors. These motors are designed especially to meet the load conditions of pumping. They handle loads without laboring or stalling... are smooth running under cyclic loads. They are uniquely suited, too, for other types of equipment that require vertical motor drives. Match them to agitators, axial fans, centrifuges, mixers, presses ... anywhere you need a vertical shaft motor.

Whatever the application, one thing is sure... Wagner advanced design engineering has produced vertical shaft motors of simple, rugged cast-iron construction... motors with plenty of stamina to give you economical, maintenance-free service the year 'round, indoors or out.

Wagner Vertical Solid Shaft Motors are end-mounted, squirrel-cage type with NEMA Type "P" base. They are available in standard ratings of 60 cycle, 208-220/440 and 550 volt, 1½ through 40 hp—3500 RPM, and 1 through 30 hp—1750 RPM. For information on larger horsepower ratings, call your nearby Wagner Sales Engineer.

Other motor requirements? Wagner can supply standard motors or build special motors to fit your needs. More than 65 years of constant research and development in electric motor design has made Wagner a name you can depend on. For an analysis of your next motor application, be it for plant or product call on Wagner. There are 32 branch offices in principal cities across the country.

Wagner Electric Corporation
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WH60-4

SERVING 2 GREAT GROWTH INDUSTRIES — *ELECTRICAL — AUTOMOTIVE*

Now—a new appearance concept for low-budget commercial installations

The "Power-Plant" Look

with Johns-Manville FIBROCEL Insulation!

Now you can bring the traditionally fine appearance and performance excellence of your power plant work to general commercial and industrial installations... with Johns-Manville Fibrocel® Insulation!

Why these power plant advantages? Simply because Fibrocel is molded! The only commercial insulation made (by a precision metal mold) to near-perfect roundness, with unmatched uniformity of size and line.

This means an immediate end to costly finishing, heavy jacketing, needless pointing up of cracks and apertures. Instead, Fibrocel gives you a tighter, better looking installation just as it is applied. Pipelines are gun-barrel straight, firm end to end. The look of a power plant!

Fibrocel's dimensional uniformity again pays off in fuel savings—pipe is always "dead center," with lengths butted tight to provide maximum insulating effectiveness.

Let us send you the informative new brochure, IN-155A. It gives you full details on Fibrocel's thermal performance. Illustrations show why Fibrocel installs easier . . . takes abuse, too. Keeps its fine appearance and performance excellence for the life of the installation. Write for it today!

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JOHNS-MANVILLE

...Specify Fibrocel for the "POWER PLANT" look in installations like these (35F to 300F)

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INSTITUTIONS

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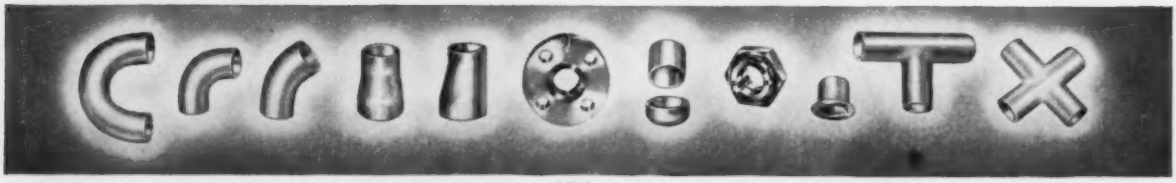
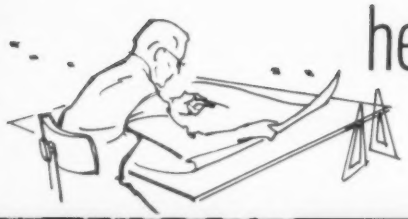


A Product of HORACE T. POTTS COMPANY • 576 E. Erie Avenue • Philadelphia 34, Pennsylvania

DUNHAM-BUSH "GOES CRITICAL"

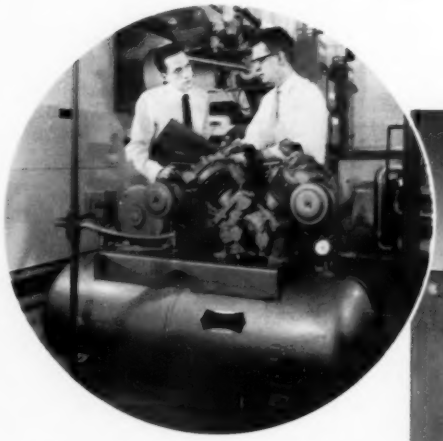
at Picker Research Center, where the handling of "hot" isotopes demands dependable, safe, efficient control of air movement and temperature



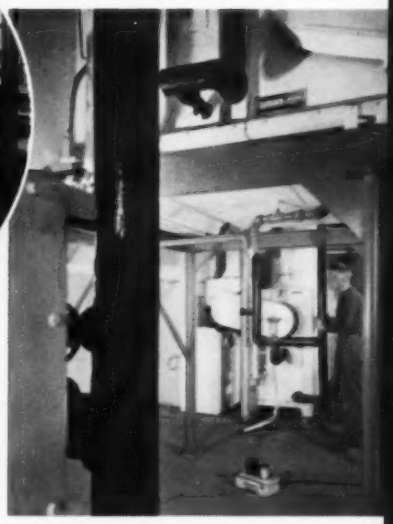
heating and air conditioning a radioisotope laboratory...

Outside the Center's million-curie test cell, looking in on the fascinating "finger" operation of the Master-Slave Manipulators as they encapsulate a radioactive material. Failure of the air system here would seriously, perhaps disastrously, impair the protective function of the cell's $10,000, 61" thick glass and zinc bromide window. Part of the cell's enormous 40-ton access door of steel and concrete can be seen in the background.

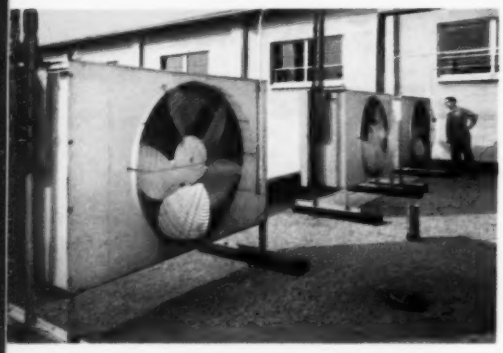
In the course of its many contracts, Dunham-Bush has satisfied an imposing variety of industrial and commercial demands for optimum heating, cooling, and air conditioning. The greater part of these demands has been commonplace. Others have been of a highly critical kind, such as those involved here at Picker X-Ray, where extremely sensitive instruments to trace and measure radioactive material are developed, and where new medical and industrial uses are created from x-rays and isotopes. E. W. Coleman, Picker's Isotope Department manager, has made the point directly,".... the handling of radioactive materials, the ... proximity of the Center to residential and industrial areas, the need for in-plant safety, employee comfort and well-being, taken together place tremendous responsibility on the air system."



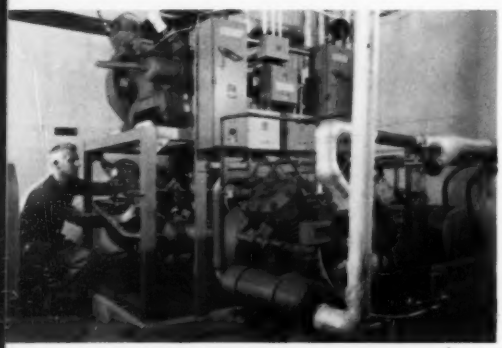
A dependable Brunner Air Compressor provides pressure for the air-operated tools in the Center's second-floor machine shop.



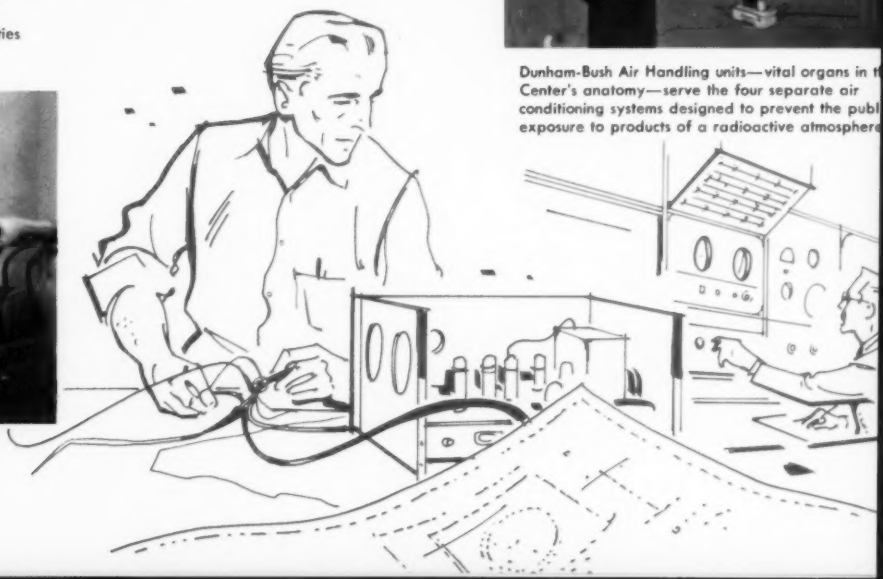
Dunham-Bush Air Handling units—vital organs in t Center's anatomy—serve the four separate air conditioning systems designed to prevent the publ exposure to products of a radioactive atmosphere



Roof-Top Dunham-Bush Air Cooled Condensers enable the Center's air conditioning systems to function without water; and problems of excessive water impurities and their disposal naturally are avoided.



Heat-X Heat Interchangers and Brunner Compressors are integral parts of the Center's all Dunham-Bush air conditioning system.

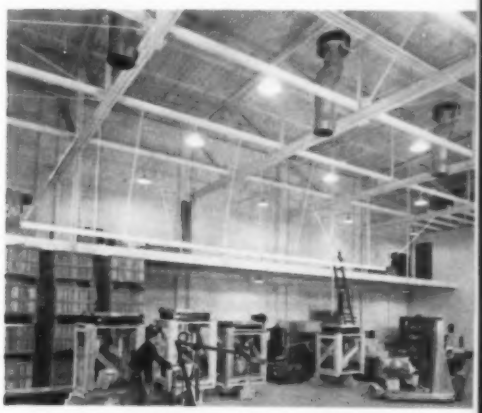


the vital responsibility of a single source

In tastefully appointed surroundings made atmospherically comfortable by Dunham-Bush air conditioning, one of the Center's receptionists greets visitors.

In winter, Dunham-Bush Cabinet Convectors with the manual adjustment feature warm the Center's non-air conditioned stairwells.

Dunham-Bush Thermo Vector Radiation sharply reduces downdrafts, and circulates warm air to every corner of the Center's engineering department.



Dunham-Bush Unit Heaters warm the Center's busy warehouse in winter. They also are used to circulate air for summertime comfort. Extension tubes funnel the air downward, past structural elements.

Architect & Consulting Engineer—McGeorge, Hargett and Associates—Cleveland, Ohio
Mechanical Contractor—The Feldman Brothers Company—Cleveland, Ohio
Wholesaler—Cleveland Hermetic & Supply Company—Cleveland, Ohio

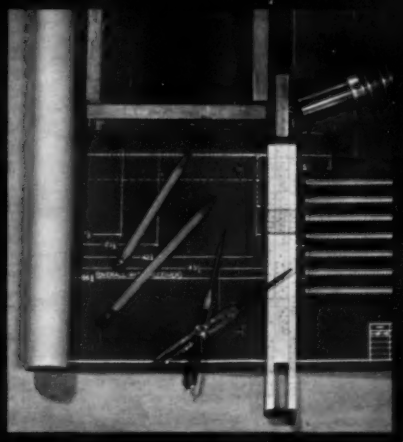
DUNHAM-BUSH . . . satisfying the common and uncommon heating and cooling demands of our time

Belle Chasse High School, Belle Chasse, Louisiana, is served by these Dunham-Bush products: Air Handling units, Comfort Conditioners, Wall Jet Unit Heaters, Electric Defrost Low Temperature units, Baseboard Radiation, Cabinet Convectors, and Unit Heaters.

Cardinal Glennon Memorial Hospital for Children, St. Louis, Missouri, uses Dunham-Bush Vacuum and Condensation Pumps, Convectors, Radiator Traps, F & T Traps and Strainers, and Unit Heaters.

And at IBM's new Engineering Laboratory, Kingston, New York, the following Dunham-Bush equipment is installed: Finned Tube Radiation, Unit Heaters, F & T Traps and Strainers, Bucket Traps and Strainers, Air Handling units, Convectors, and Low and High Pressure steam specialties.

To specifiers, buyers, and users of Dunham-Bush equipment, the reassuring significance of the Picker installation is simply that whatever the demands for performance proficiency, this single source responsibility meets them with the same high-quality equipment . . . equipment that always ensures top-drawer efficiency and safety.



Pictorially expressed above are the ingredients of the directed effort made by our engineering and production team in the interests of public and private comfort, safety, and productivity.

Call on Dunham-Bush for responsible performance of any heating or cooling job.

DUNHAM-BUSH

Dunham-Bush, Inc.

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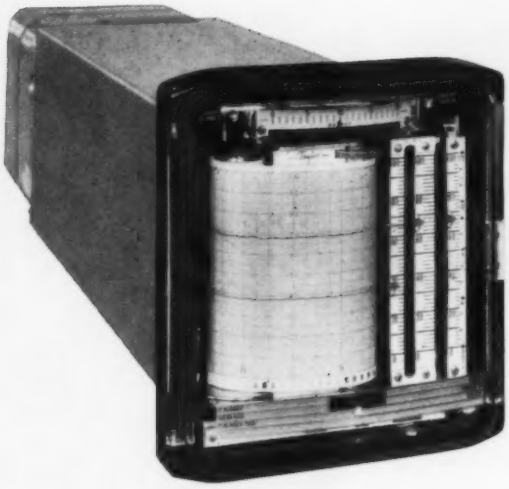
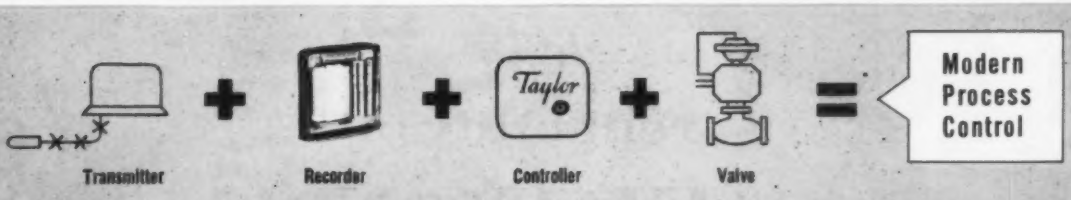
Taylor TRANSCOPE® RECORDER



. . . the finest miniature recorder ever produced for the Air-conditioning field



No other recorder, regardless of size, puts so many features in so little panel space

The Taylor Transcope Recorder (90J) is now generally recognized as the most modern, most convenient and most accurate instrument for recording process variables at a central point.

Servo-Operated Pens have 150 times greater power, assuring unprecedented accuracy of records.

Front-of-Panel Control Settings let you make adjustments easier, quicker and better . . . *from the front of panel* . . . while recording!

Stays on Automatic Control while the plug-in recorder slide is removed for inspection, yet providing continuous fully automatic control.

Complete Indicating Control Station while recorder is removed. Horizontal gage at top of recorder will show either process variable or air output to valve, as desired.

Receives Three Variables to be recorded or indicated; has a Set Point Transmitter; Process Alarms with Memory Pointers; an Automatic-to-Manual switching lever; a cascade of Process-output Indicator, and many other features . . . all in a compact case.

See your Taylor Field Engineer, or write for **Catalog 98286.**
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Taylor Instruments **MEAN ACCURACY FIRST**

The reliability of FREON® originates here

Du Pont's years of experience and progressive research assure you of unsurpassed quality every time you buy Freon* refrigerants. Factory-sealed cylinders guarantee purity. Insist on genuine "Freon" refrigerants—the gold hood cap identifies its premium quality.

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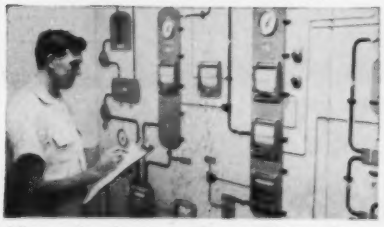
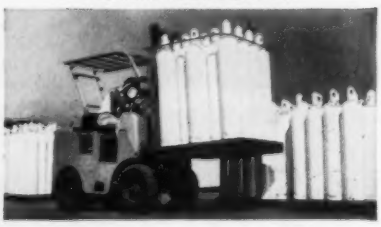
E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division, Wilmington 98, Delaware

MANUFACTURING CONTROL



LABORATORY CONTROL

UNLIMITED SUPPLY



*Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.

you'll want to know...

Air Conditioned School Offers Better Building for Less Money

CONSTRUCTION plans for two schools, one in the South and one in the North, were cited last month as proof that educational plants designed around air conditioning cost no more and can be even less expensive than those with conventional heating and ventilating systems.

The F. Ware Clary Junior High School in Syracuse, N. Y., will cost $16 a sq ft, or 94 cents per cu ft. In comparison, the cubic foot price for the William Nottingham school in Syracuse was $1.09 and $1.38 for the Syracuse Central Technical-Industrial School, both of which were not air conditioned. The figures for both air conditioned schools include the investment in air conditioning equipment, and are equal to or below the average for non-air conditioned schools in the same geographic locations, as illustrated by the Syracuse cases.

These findings signal a halt in the upward trend of school construction expense, according to Charles V. Fenn, vice president of Carrier Corp.

"The Clary school will demonstrate that construction savings ranging as high as 10 to 15 percent in some areas can be achieved by designing around air conditioning," Mr. Fenn said. "This benefit can be added to the obvious ones resulting from the year 'round introduction and cleaning of outdoor air with temperature, humidity, and circulation under control."

The developer of the plans, Murray Hueber of the architectural firm of Pederson, Hueber, Hares and Glavin, said major savings in construction stem from the use of the compact rectangular buildings made possible by air conditioning. Up to now, modern schoolhouse design has featured a number of long narrow classroom wings to obtain cross ventilation and some relief from the excess heat generated by healthy youngsters, modern lighting, and the sun.

The new school now under construction at Meachem Field will be in two simple rectangular sections connected by an enclosed passageway. One building will house 31 classrooms, and the other will contain vocational shops, an auditorium, gymnasium, cafeteria, and the administrative offices.

Mr. Hueber estimated that use of such a design rather than a group of classroom wings has reduced the length of foundation wall by 1100 ft, the amount of masonry side wall above ground by 9100 sq ft and considerable savings in less glass used.

In addition, less piping will be needed for storm drains, sanitary sewers and domestic hot water. Power lines can be shortened and will be of lighter gage.

Savings from these will amount to about $150,000 with no loss in floor area. The cost of the cooling equipment for the year 'round air conditioning system is about $95,500. The net reduction in cost is therefore $54,500.

The savings could have been ever greater, Mr. Hueber said, except that cooling and heating equipment and pipe sizes to be installed are larger than the building presently requires. They have the capacity to handle an expansion in classroom area of 50 percent if future needs require it.

Overall cost of the Syracuse air conditioned school was set at $2,033,000. Without air conditioning and the more compact layout it allows, the investment in a school of this pupil capacity with conventional heating and ventilating would have been $2,087,000.

Mr. Hueber summed up the dif-

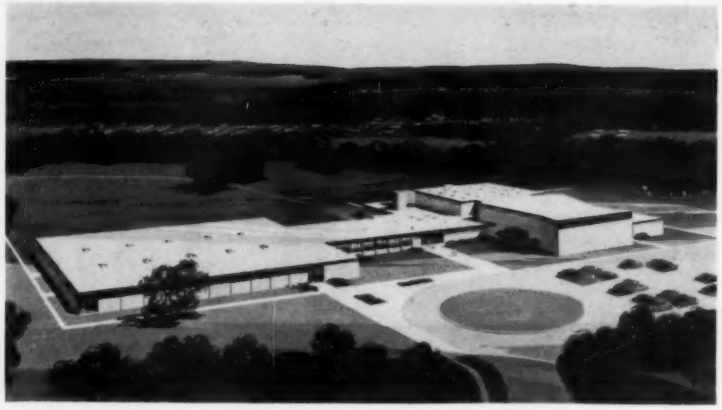
ference between the compact air conditioned structure and the type incorporating extended classroom wings:

"Economy is possible with compact construction, but compact construction is not possible without air conditioning."

In addition to reduced construction cost, the new type of school building will offer greater operating economy. Dr. Paul A. Miller, superintendent of Syracuse schools, estimated that filtering of outdoor air before it enters will cut cleaning and maintenance expense by about $4000 a year. Also, air conditioning offers the great advantages of permitting better teaching and learning and of being completely usable day or night in any season, according to Dr. Miller.

The mechanical contractor for the new F. Ware Clay Junior High School is Kenneth A. Taylor, Inc.

A new 2200 pupil junior-senior high school being built in Abilene, Texas, is priced at $11 a sq ft exclusive of land and furniture. All nine buildings, except the two gymnasium buildings, will be air conditioned.



AIR CONDITIONING WILL LOWER COST of building F. Ware Clary Junior High School, Syracuse

SEVEN OF NINE BUILDINGS on Abilene, Texas junior-senior high school campus will be air conditioned

Portable Heater Speeds Production Of Pilot-Plant Drugs

RAPID conversion of chemical reaction vessels into high temperature reaction units is made possible with a new portable electric resistance heating unit used by Ciba Pharmaceuticals, Inc., according to Hynes Electric Heating Div., Turbine Equipment Co. The unit was designed and engineered for high temperature operation at low pressures and in hazardous atmospheres.

High temperature reactions present a problem in the pilot-plant stage of process development for many new drugs and pharmaceuticals. At these high temperatures, process steam pressure is higher than the rated pressure of the 50 gal reaction kettles used in pilot-plant studies at Ciba's facilities. The kettle jackets are rated for a pressure of about 15 psig.

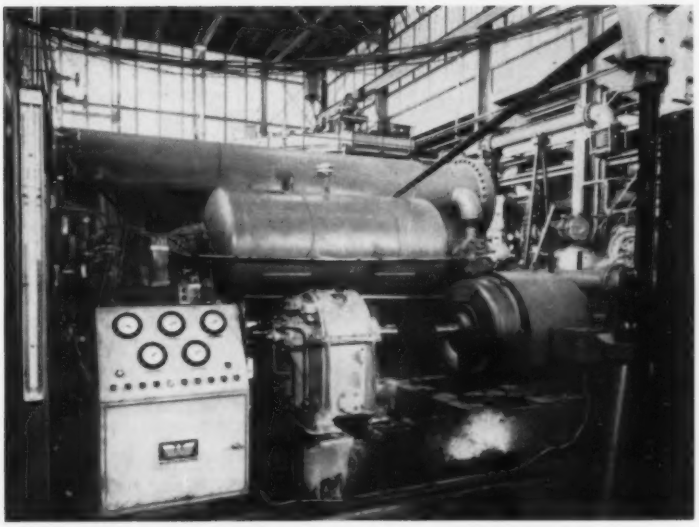
The new portable unit keeps positive pressures down to one to two psig in the kettle jacket at reaction temperatures of 600 F. The versatile packaged heating system uses a low vapor pressure heat transfer medium to heat the jacketed reaction vessels. A canned rotor centrifugal pump circulates the heated medium at 50 gpm against a 30 ft head.

Each reactor vessel in pilot-plant operations thus becomes a potential high temperature reaction unit through the flexibility of the portable heating unit. Three men can relocate the unit.

ARI Establishes Unitary Test Pattern

A "random testing" pattern under which at least four air conditioning units will be tested every month to determine whether their rated capacities are met by the stock units themselves has been established by the Air-Conditioning and Refrigeration Institute.

The units to be tested are to be withdrawn at random from the stocks of distributors, under provisions of the ARI unitary air conditioner certification program. Under the random testing procedure, with no manufacturer knowing when or what model of his output will be subjected to test, it is felt that all units will be kept in line with provisions of the applicable ARI standards, and up to the advertised capacity ratings.



Air Force Uses Packaged Air Conditioning In ICBM Bases

THE FIRST operational Titan ICBM bases now being built near Denver, Colo., will be supplied with $5 million worth of air conditioning, diesel engines, generators, compressors, and a wide range of instrumentation equipment, according to Worthington Corp.

All of this equipment will be supplied in a package which meets unusually high shock requirements without the addition of protective mountings.

The Titan bases, Squadrons I and II, which will cost $67 million, are under construction on the Lowry Air Force Base bombing range outside Denver. Completely underground with reinforced concrete walls ranging from 1 ft to 10 ft thick and utilizing shock resistant equipment throughout, the two squadrons will provide six entirely self-sufficient missile launching sites. The missiles themselves will be stored and fired from silos extending underground 165 ft, or approximately 15 stories.

Each squadron consists of three launching pads together with underground chambers for equipment and personnel. Each pad will have its own powerhouse containing four diesel engines driving 1000 kw generators and two 300 ton air conditioning units. Compressors for shop and instrument air will be located in equipment terminal buildings.

Air Conditioning Association Presents Donation to College

THE Western Air Conditioning Industries Association recently presented a donation to the California State Polytechnic College Air Conditioning Department. The donation, the second made by the Association, is for use in developing relations between that school and high schools and colleges of California.

In accepting the donation, Harold P. Hayes, Dean of the College, pointed out that, "The program is intended to acquaint high school and junior college students with the broad opportunities available in the air conditioning industry."

The college offers a varied educational program designed to prepare students for positions in the air conditioning industry, through its special department.

To Feature Large Oil Burning At OHI Convention

SPECIAL MEETINGS for the commercial-industrial section of the Oil Heat Institute of America, Inc. will be held each day of the OHI's forthcoming 23rd annual convention in April at the Park Sheraton Hotel in New York City. These special sessions will be held at 10:00 a.m. and will close at 12:00 noon.

The OHI convention opens on Monday, April 4, and continues through Thursday, April 7. For more information, write to Charles Pesterfield, Commercial-Industrial Section secretary, Oil Heat Institute of America, 500 Fifth Ave., New York 36.

Large Air Conditioning System To Serve Bank

THE NEW 31-story First City National Bank Building will own the largest air conditioning system serving a single structure in Houston, according to an announcement from Carrier Corp.

Three steam driven centrifugal water chilling machines will provide a total of 3600 tons of cooling capacity for the 900,000 sq ft of floor space to be in use by late 1960.

The planned high velocity system will supply conditioned air to 3045 units serving offices lining the exterior walls of the structure, which covers a square block at the two-story base. Units will be furred into the aluminum and glass-sheathed walls at sill height, with space beneath used for piping and feeder ducts.

With the exception of the refrigerating machines, most of the mechanical equipment will be housed in the top two floors of the 29-story office tower. Jaros, Baum & Bolles, consulting mechanical engineers, designed the installation.

Sidewalk Snow Removal System Uses Heat Pump for Partial Output

AN AUTOMATIC snow removal system has been installed in two concrete sidewalks bordering the new Columbus and Southern Ohio Electric Co.'s 10-story office building in Columbus, Ohio. One sidewalk is 200 ft long and 15 ft wide, while the other measures 100 by 15 ft.

Completely embedded in 5½ in. thick structural slabs are pipe grids spaced on 12 in. centers. The system eliminates snow shoveling and salting and cindering the walks. It can be operated either automatically or manually by circulating lightweight heat transfer oil at a rate of 350 gpm. A 650 ton heat pump is used for both heating and cooling operations. The oil is circulated through the system at 95 F.

According to A. M. Byers Co., this snow melting system is the only one utilizing partial output from a heat pump designed primarily for a building heating system. Engineers designed the system to compensate for outdoor temperatures as low as −10 F. Since snow falls in Columbus at approximately 36 F, part of the heat pump output at this temperature can be used for the snow melting system.

Industrial Environment Studies Available

IN ITS NEW "Hygienic Guide for Antimony," the American Industrial Hygiene Association warns against the placement of persons with a history of heart disease in any industrial exposure where antimony is present as an air contaminant.

At the same time, the association released similar guides on contaminants hydrogen selenide, styrene monomer, and ethylenediamine.

Each guide provides confirmed data relative to the degree of hazard in industrial exposures, tested identification and control procedures, and steps to be taken in the event of poisoning, as well as a bibliography of literature published to date.

Guides are available at nominal cost from the association, 14125 Prevost St., Detroit.

Kahn Organization Adds Associates

ALBERT KAHN Associated Architects and Engineers, Inc. recently elected the following employees as associates: R. Hudson, C. M. Labunski, J. Nachbar, J. S. Pettitt, and S. D. Popkin.

ARI Issues 1960 Directory

THE Air-Conditioning and Refrigeration Institute has issued the 1960 Directory of Certified Unitary Air-Conditioners, in which 1995 models of approximately 50 manufacturers are listed.

The directory is being distributed to dealers and contractors throughout the country, to architects and consulting engineers, to government personnel concerned with air conditioning at national, state, and local levels, and is available to the public through the dealer and contractor outlets of the participating manufacturers. The Directory also will be available through Better Business Bureaus throughout the country as well as ARI headquarters in Washington.

HPAC Index for 1959 Available Soon

FOR YOUR convenience, the editorial content of HPAC is indexed annually. The 1959 index is now in preparation and will be available early in 1960 to subscribers on request.

To obtain your free copy, write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

1960 Construction Predicted to New High

CONSTRUCTION volume in 1959 registered its greatest annual increase in 10 years, climbing to a total of $73 billion, and prospects are bright for another record breaking year in 1960, according to the Associated General Contractors of America.

The 1959 total consisted of $54 billion in new construction put in place and an estimated $19 billion in maintenance and repair operations. Construction broke dollar volume records for the 14th successive year, continuing to account for more than 15 percent of the gross national product and for some 15 percent of the nation's total employment, directly and indirectly.

A total of more than $76 billion is forecast for 1960 made up of $56.1 billion in new construction and about $20 billion in maintenance and repair. The figures do not include work in the new States of Alaska and Hawaii, nor overseas construction performed by the American government and private enterprises.

New Panel Heating Bulletin Available from Univ. of Ill.

ENGINEERING EXPERIMENT STATION Bulletin No. 453 just made available by the University of Illinois presents the results of comprehensive tests made on floor panel and ceiling panel heating systems in a special laboratory. The studies were conducted under the sponsorship of the Institute of Boiler and Radiator Manufacturers and as a part of the heating and air conditioning research program in the department of Mechanical Engineering. The authors of the new bulletin are Professor Warren S. Harris and Everett L. Sartain. The cost of the bulletin is $1.00, and copies may be obtained from the Engineering Experiment Station at Urbana, Ill.

Solar Energy Symposium Scheduled for April 4, 5

THE SOLAR ENERGY SYMPOSIUM to be held at the University of Florida on April 4 and 5 will include several sessions on such subjects as present importance of solar energy, basic considerations, solar collectors, water heating, refrigeration, and others. Information may be obtained from Professor E. A. Farber, mechanical engineering department, University of Florida, Gainesville.

Cooled Cars Up Traffic On "Hudson Tubes" Railway

AIR CONDITIONING in the 50 new cars of the Hudson & Manhattan Railway (Hudson Tubes), resulted in a noticeable increase in summer traffic, on some days by as much as 15 percent, according to officials of the railway and its equipment suppliers.

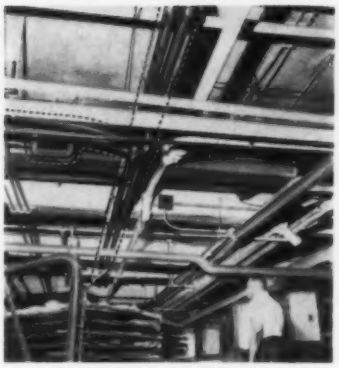
Each car in the newly purchased rapid transit group accommodates 44 seated passengers, with a maximum capacity of 152. Results obtained from the air conditioning equipment in this type of service are said to be highly satisfactory.

Dr. Silverman Named AEC Committee Chairman

DR. LESLIE SILVERMAN, professor of engineering in environmental hygiene and director of the radiological hygiene program of the Harvard University School of Public Health, recently was elected chairman of the Atomic Energy Commission's advisory committee on reactor safeguards.

The advisory committee reviews safety studies and facility license applications referred to it and advises the Commission on the safety aspects of proposed or existing reactor facilities.

Dr. Silverman is the author of many articles on the subjects of air pollution control, industrial ventilation, and air analysis.



How Insulation Solved Rubber Processing Plant Condensation Problem

THE problem of condensation was eliminated in the Firestone Tire & Rubber Co.'s Akron, Ohio, plant through use of chilled water lines, according to Armstrong Cork Co. These lines, which lead from a refrigeration unit to the general offices, were run through the rubber processing area where high humidity exists.

To prevent vapor from forming on the outside of the chilled water lines, a flexible foamed plastic insulation material was used. The insulation had to be of durable quality and easy to maintain, since replacement would disrupt normal work flow in the plant area.

The lines, which are 1⅛ in. and 1⅜ in. are run over a skid storage area for processed rubber. Condensation on the lines would make a traffic aisle slippery and would fall on stored material and a portion of a conveyor.

The insulation material used on the pipes has a built-in vapor barrier in addition to preventing condensation. Its closed cellular structure provides high thermal efficiency and prevents warm, humid air from coming into contact with the cold lines.

Three Concentric Pipes Solve Pipe Stress Problem

A UNIQUE SOLUTION to the problem of thermal expansion and contraction in an undersea pipeline used in transporting molten sulfur at 300 F has been found to be successful. The line is buried 5 ft in the ocean floor and is used to deliver 4500 long tons daily from a man-made Gulf of Mexico island to the Freeport Sulphur Co. barge loading point at Grand Isle, La.

Three concentric pipes are used; an inner 6 in. pipe for sulfur, a middle 7⅝ in. pipe to serve as a hot water jacket to keep the sulfur in a molten state, and an outer 14 in. pipe for protective casing.

With the line on the ocean floor, the outer casing ends were anchored under 10,000 psi tension. Heating the inner lines allowed them to expand 35 ft in length, and their ends were then anchored to the outer casing. The entire line was then buried.

Heating the pipeline from an operating temperature of 75 to 300 F would normally cause a 55 ft expansion in length over the course of the line. However, with the "stretch" already applied, the thermal effect first relaxes the stresses before expanding, so that terminal stress reaches only 60 percent of the pipe's yield strength. Cooling of the line to atmospheric temperature creates reverse tensions as the pipe tends to shrink, but the force is less than 70 percent of yield strength. Almost no linear movement in the pipe has been experienced.

The pipeline was installed at a cost of $30 million, according to Jones & Laughlin Steel Corp.

Flexible Rubber Pipe Used in Waste Disposal

ONE of the largest installations of its kind was recently completed in New Jersey, when an 1864 ft length of large diameter flexible rubber pipe was laid from the shore to the channel of the lower Delaware River. The pipe was designed to discharge processing wastes from a large chemical plant in that area, according to the Manhattan Rubber Div., Raybestos-Manhattan, Inc.

The line was installed from an off-shore dredge which first scooped out a trench for it on the river bottom. Successive 50 ft flanged lengths were bolted together, using corrosion-resistant bolts and nuts. Flexibility of the line simplified bolting operations. The free end was just lifted out of the water without disturbing the sections already in place, and attached to the next length on the dredge. Then the dredge backed off one pipe length and dropped the newly attached length in place. A heavy cast iron collar bolted to each rubber pipe anchored it to the bottom.

This procedure was far simpler than underwater bolting or welding that would have been necessary with a metal pipe line, according to the user. An unprotected metal would have a relatively short life in the Delaware River at this point because of salt water corrosion, aside from the fact that the line itself carries nitric and sulfuric acid wastes.

The method of disposal was developed by the chemical firm's engineering department as a conservation measure. It provides for rapid dispersal of wastes by discharging them into the faster moving river channel, rather than directly offshore into shallow tidewater. Details were worked out with the U.S. Army Corps of Engineers.

Although it is operated as an open-end 12 in. diameter pump line, the rubber pipe is designed to withstand 100 psi. This strength is provided by a nylon and steel wire carcass. A neoprene cover is used for protection against external damage, above or below water. Depending upon the tides, 50 to 80 ft of the line could be exposed to weathering and floating debris.

To Discuss Release of Radioactive Debris Into Atmosphere

A DISCUSSION of the ways in which radioactive debris from nuclear tests is transported in the atmosphere, especially at high levels, has been arranged by the World Meteorological Organization at the request of the United Nations Scientific Committee on the Effects of Atomic Radiation.

Twelve specialists from eight countries have been invited by WMO to take part in the discussion. They will deal with the observed distribution of radioactivity in the atmosphere at all levels; with the transport of this material by upper winds; with the ultimate disappearance of the material from the atmosphere as fallout, both in solid form and as brought down by rain; with the observed distribution of past fallout; and with methods of predicting future fallout from past tests.

Crane Co. Purchases Swartwout Co.

CRANE CO. purchased the business and assets of the Swartwout Co. for an undisclosed amount of cash last month. The company will operate as a division of Crane Co. and will continue under the guidance of Kenyon and Charles Swartwout.

Ventilation Conference Scheduled for Feb. 15-18

THE 9th annual industrial ventilation conference at Michigan State University will be held February 15-18, 1960, at East Lansing, Mich., in the Kellogg Center. The conference is co-sponsored by the College of Engineering of MSU and the Michigan Department of Health.

Information about the conference may be obtained from Michigan State University, Kellogg Center for Continuing Education, East Lansing, Mich.

Robert A. Wasson New Clarage Fan Head

ROBERT A. WASSON was elected president and general manager of the Clarage Fan Co., at a meeting on January 18 of the firm's board of directors.

Mr. Wasson has been vice president and general manager since 1945, and he succeeds Harry R. Clarage, who died suddenly on December 26, 1959.

Mr. Wasson is a 1922 graduate of Cornell University with a degree in mechanical engineering. He has been active in the air moving industry, having served two terms as president of the National Association of Fan Manufacturers, as well as serving on the board of directors and several committees of the Air Moving and Conditioning Association. He was also president of the New York Chapter, American Society of Heating and Ventilating Engineers.

For the first time!

Everything you need in Dial Thermometers for Piping and Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

Easier to read

Illustrations tell the story. Four types, seven ranges—72 stock combinations to meet every condition. Big, legible 3½" and 4½" dials . . . easy to read in places where piping and duct thermometers must be installed. Ease of reading further increased by provision for tilting and turning dials to any desired reading angle. Line includes distant reading types that take care of remote locations.

Unbreakable—more accurate

Instead of fragile difficult-to-read glass tube thermometers you now have sturdy, unbreakable, legible Marsh Dial Thermometers. Guaranteed accurate to plus or minus one division of the scale, they have far greater *readable* accuracy than any glass tube type. All have the famous Marsh "Recalibrator"—to *keep* them accurate.

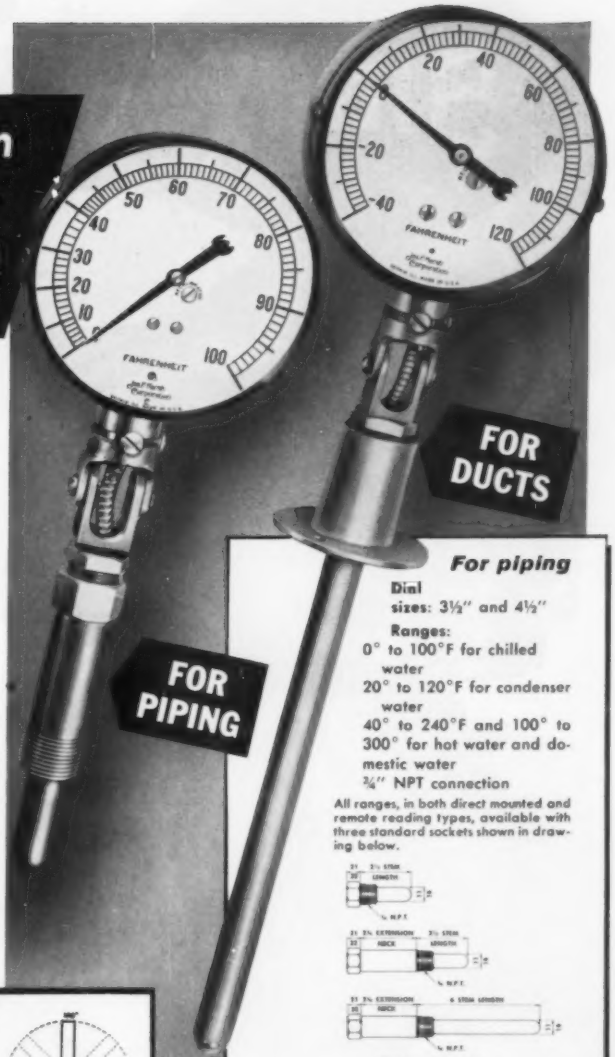
All purpose

Design provides for every on-the-job condition. Separable sockets ("wells") simplify installation—or removal for servicing. Extension necks take care of insulation on piping or ducts. Long stems in duct type put temperature-sensitive section where it belongs.

Note the brief specifications opposite. Any thermometer is available from stock.

Write for bulletin telling the whole story.

Marsh Instrument Company
Division of Colorado Oil and Gas Corporation
Dept. T, Skokie, Ill.
Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta



For piping

Dial sizes: 3½" and 4½"

Ranges:
0° to 100°F for chilled water
20° to 120°F for condenser water
40° to 240°F and 100° to 300° for hot water and domestic water
¾" NPT connection

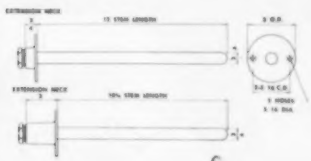
All ranges, in both direct mounted and remote reading types, available with three standard sockets shown in drawing below.

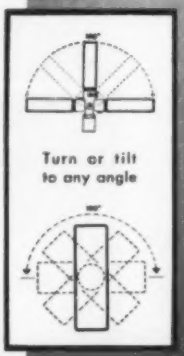
For ducts

Dial sizes: 3½" and 4½"

Ranges: −40° to +120° F
0° to 160° F
0° to 220° F

All ranges, in both direct mounted and remote reading types, available with standard extension necks and stems shown in drawing below.

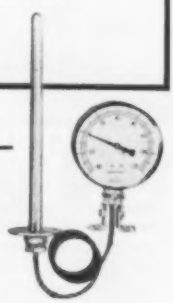




MARSH
DIAL THERMOMETERS

Also remote reading—

Piping and duct thermometers of same basic design available with 6 ft. of capillary tubing as shown.



SIOUX impact offer Torque

The SIOUX No. 318, 5/8" drive, is shown removing 5/8" bolts on the head of a steam condenser, part of a turbine driven, centrifugal refrigeration machine air conditioning installation. This head has to be removed once a year for cleaning the tubes.

Here the SIOUX No. 322, 1" drive, is removing 7/8" bolts from the head of a heat exchanger, part of an air conditioning installation which uses river water. Tubes must be cleaned monthly in the summer time in order to keep the heat transfer at efficient levels, particularly as the river water is dirty.

The SIOUX No. 322 here is removing 3/4" bolts on the water end of a boiler feed pump. This is a yearly maintenance operation for reseating valves, etc.

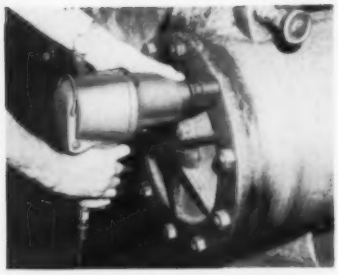
SIOUX *Electric*

IMPACT WRENCHES

Sioux electric impact wrenches offer equal power in right or left hand rotation. The torque for each wrench is stated and certified. Their mechanical design offers exactly the same advantages as that of the air wrenches. Their exclusive reverse cap switch lock prevents reversing with the current on, and eliminates burning commutator brushes and switch contacts. They are unexcelled in performance.

wrenches

for every task!



This photo was taken in a boiler room and shows the Sioux No. 322 removing ¾" bolts from the steam end of a boiler feed pump. This must be done yearly for pulling pistons for maintenance.

CERTIFIED SIOUX POWER

SIOUX tells you the torque your air or electric impact wrench will deliver. (See specifications.) You don't buy just a wrench. You buy certified Sioux power! Reversible power. And on air wrenches controllable power through eight point power selector.

PROVEN EFFICIENCY

Here, the advantage of the exclusive Sioux mechanical design is revealed! You can expect your Sioux air impact wrench to deliver *15% more torque* while *consuming 30% less air!* Less power is absorbed by the wrench itself. More is applied to the drive!

FIELD TESTED, TIME TESTED PROVEN DEPENDABILITY

The exclusive Sioux impact wrench mechanical design has passed the toughest test of all . . . the test of time. Thousands have been giving dependable, trouble-free service for years.

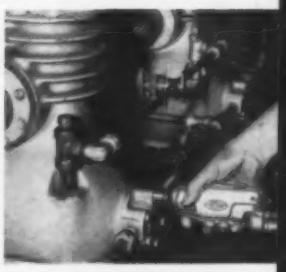
REACTION BALANCED for Less Vibration Feedback

All Sioux Impact Wrenches are "reaction balanced" for less vibration and torque feedback and for minimum operator fatigue. You can feel the difference!

ANGLE ATTACHMENT— used directly on the square of the impact wrench to reach those hard to get at spots.

NO. 313, 314 SIOUX AIR IMPACT WRENCHES

These models feature an exclusive, remote air exhaust that carries exhausting air, and oil 6 feet from the operator, for quieter, cleaner operation. They're designed for use in restricted space, where necessary.



The Sioux No. 313 with ⅝" wrench, ⅜" drive is being used on a boiler control to replace a diaphragm and make other repair. As these boilers furnish steam for driving turbines, that drive refrigeration machines in summer and steam for heating in winter repairs have to be made quickly.

Compare the TORQUE! the QUALITY!

Cat. No.	AIR Square Drive	Cap. Bolt Size	Torque Ft. lbs. at 90 lbs. Air Pressure at Tool
313	3/8"	3/8"	60
314	1/2"	7/16"	75
303*	1/4" Hex		
315	1/2"	5/8"	130
312*	7/16" Hex		
316	1/2"	5/8"	195
317	5/8"	5/8"	195
318	5/8"	3/4"	250
319	5/8"	7/8"	425
320	3/4"	1"	750
322	1"	1 1/8"	1000

*AIR SCREWDRIVER

Cat. No.	ELECTRIC Square Drive	Cap. Bolt Size	Torque Ft. lbs. in 10 sec. operation Right or Left
323	3/8"	7/16"	75
333	1/2"	7/16"	75
325	1/2"	5/8"	125
330	1/2"	5/8"	175
335	5/8"	5/8"	175

ALSO NO'S. 260, 262, 242, 246 ELECTRIC SCREWDRIVERS

SIOUX's the BUY!

AIR IMPACT WRENCHES • AIR SCREWDRIVERS • DRILLS • "PELICAN" NUT ACCUMULATORS • FLEXIBLE SHAFTS • ELECTRIC IMPACT WRENCHES • GRINDERS • SANDERS • POLISHERS • SCREWDRIVERS • PORTABLE SAWS • VALVE FACE GRINDING MACHINES • ABRASIVE DISCS

ALBERTSON & CO., INC. SIOUX CITY IOWA, U.S.A.

THE RIGHT THERMOSTAT FOR EVERY PURPOSE

ROOM THERMOSTATS

Single-temperature, dual-temperature (day-night, heating-cooling), and submaster thermostats in a wide selection of models. Proportional or two-position action. Direct or reverse acting. Sensitive bimetallic measuring elements. Wide selection of adjusting features.

HEATING-COOLING THERMOSTATS

Two-pipe room types with two bimetallic measuring elements and concealed types with remote bulb liquid filled measuring elements. Direct acting for heating; reverse acting for cooling. Proportional action. Manual or automatic change-over. Choice of adjusting features.

INSERTION THERMOSTATS

Available with liquid-filled sensitive elements and rod-and-tube type sensitive elements. Rigid stem. Proportional or two-position action. Direct or reverse acting. Adjustable sensitivities. Available with pneumatic follow-up movement (pneumatic feedback) for extreme accuracy at low sensitivities.

IMMERSION THERMOSTATS

Wide choice of models with same selection of features as Insertion Thermostats.

REMOTE BULB THERMOSTATS

For applications requiring location of thermostat at a distance from the point of temperature measurement. Liquid-filled measuring elements with capillary lengths to 85 ft. Proportional or two-position action. May be converted from direct to reverse acting. Available with follow-up movement (pneumatic feedback) for accurate control at low sensitivities.

SUBMASTER THERMOSTATS

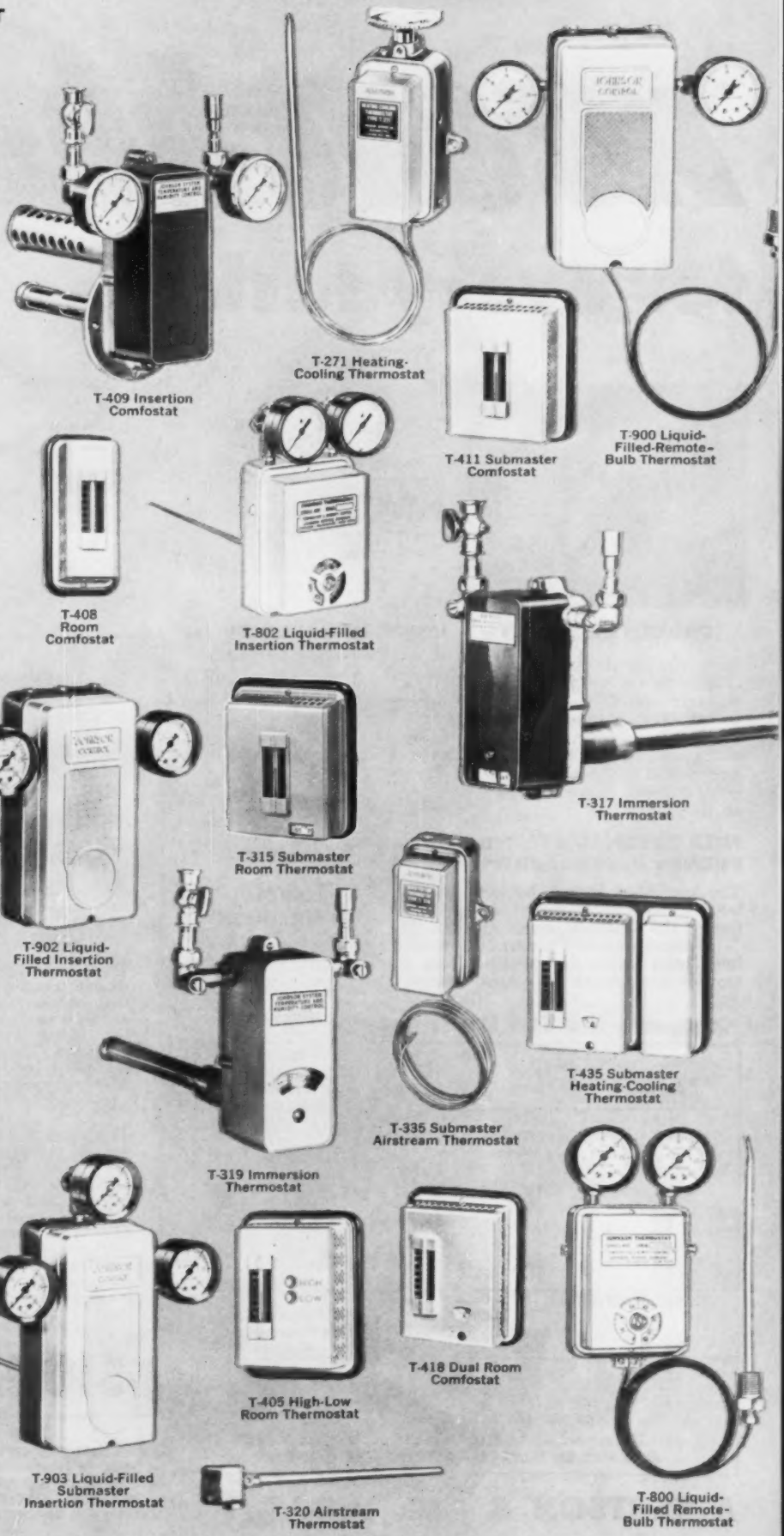
Insertion, immersion and remote-bulb types. Set point may be varied from a remote point by action of another (master) controller. Available with liquid-filled stem and remote-bulb measuring elements. Direct or reverse acting. Proportional or two-position action.

AIRSTREAM THERMOSTATS

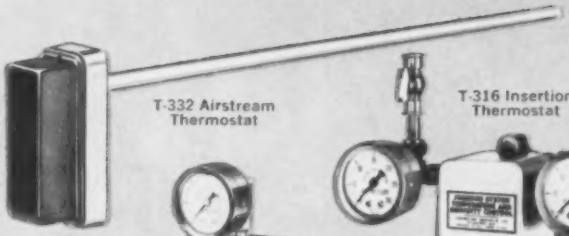
Available with flexible 8-ft. liquid-filled averaging element or rod-and-tube type element. Direct acting, proportional action. Adjustable sensitivity. One- and two-pipe models.

COMFOSTATS

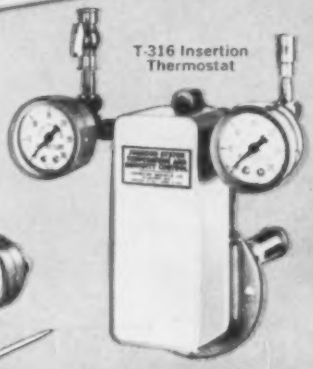
An exclusive Johnson instrument that controls from "effective" temperatures, regulating temperature in proportion to changes in relative humidity. Bimetallic temperature measuring elements; choice of humidity elements. Proportional action. Direct or reverse acting. Single- and dual-temperature room types, insertion type, and submaster type models available.



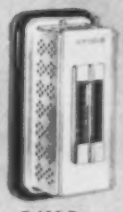
T-465 Dual Room Thermostat



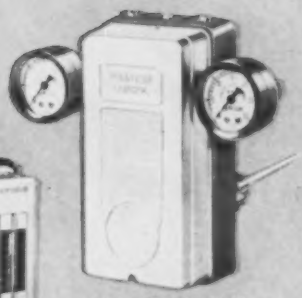
T-332 Airstream Thermostat



T-316 Insertion Thermostat



T-400 Room Thermostat



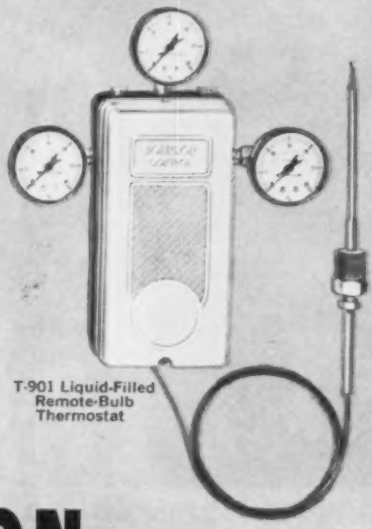
T-904 Liquid Filled Immersion Thermostat

T-905 Liquid-Filled Submaster Immersion Thermostat

T-281 Heating or Cooling Thermostat

T-333 Remote-Bulb Airstream Thermostat

T-318 Two-Position Insertion Thermostat



T-901 Liquid-Filled Remote-Bulb Thermostat

T-423 Heating-Cooling Thermostat

T-804 Liquid-Filled Immersion Thermostat

T-432 Heating-Cooling Room Thermostat

T-460 Day-Night Room Thermostat

JOHNSON THERMOSTATS

for Air-Conditioning, Heating, Ventilating, and Process Control

"The right equipment, properly applied" has always been a basic Johnson rule. That's why Johnson makes the most complete line of pneumatic control equipment in the industry, including, of course, a thermostat for every application.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

JOHNSON SERVICE COMPANY
507 East Michigan Street, Milwaukee 1, Wisconsin

- ☐ Have a Johnson engineer call on me.
- ☐ Send your new condensed catalog of all types of Johnson Pneumatic Control equipment.

OUR 75TH YEAR

Name

Title

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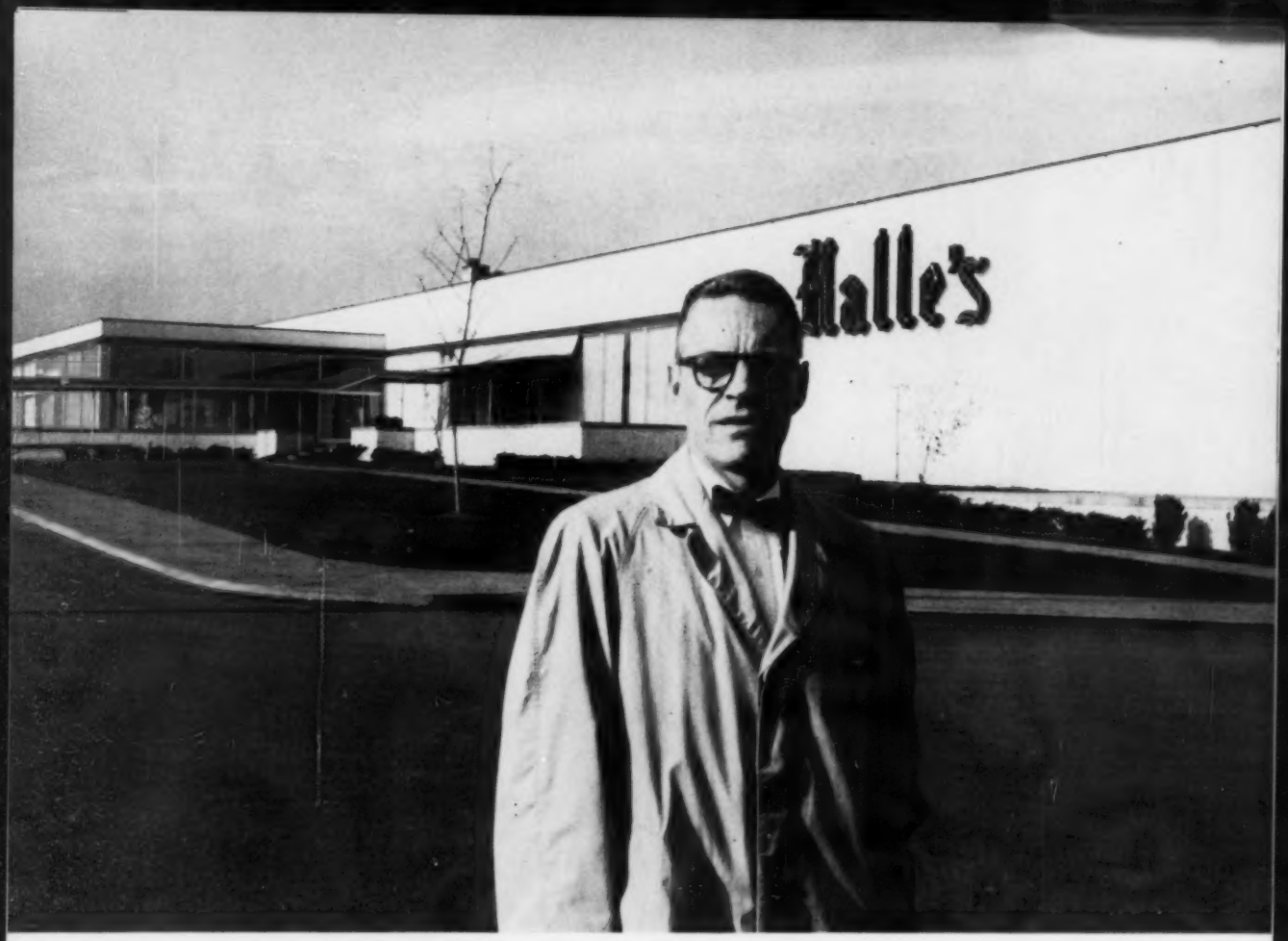


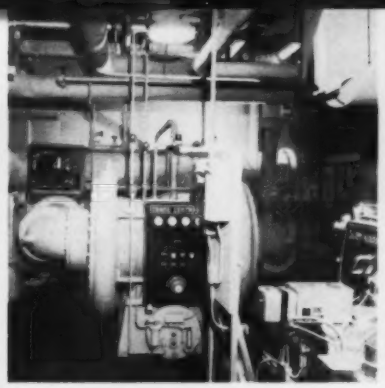
J. L. VanNort, Midwest Regional Sales Manager. Shoppers are cool and comfortable in Halle's modern store in suburban Cleveland, Ohio, which utilizes two 200 hp. Reliance Hermetic Refrigeration Motors that drive two-stage centrifugal compressors.

"Duty Master *has* what air conditioning customers expect in a motor... uninterrupted, trouble-free operation

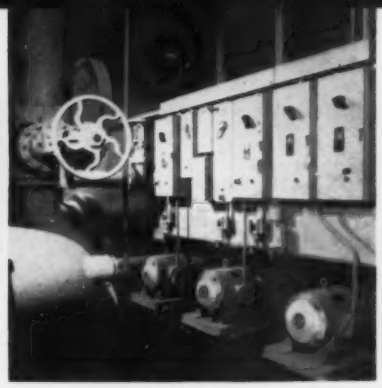
"The new Duty Master A-c. Motor has all the inherent design characteristics that keep it operating when you need it most. There's a Duty Master built for *every phase* of an air conditioning system . . . from the giant Hermetic motors to rough, outdoor applications. Many of the reasons for Duty Master's adaptability to this field stem from its qualities of built-in protection. So you get the benefits of low maintenance and *uninterrupted service.*

"Our Reliance engineers work constantly with equipment builders, consulting engineers, contractors and end users . . . to come up with sound applications of Duty Master Motors that completely match their needs."

RELIANCE - R Duty Master A-C. MOTOR

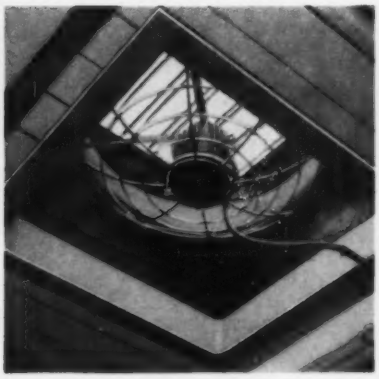


Centrifugal Compressors

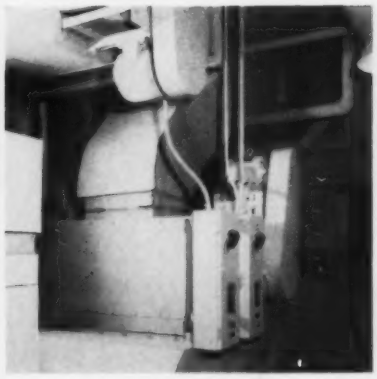


Chilled Water Pumps

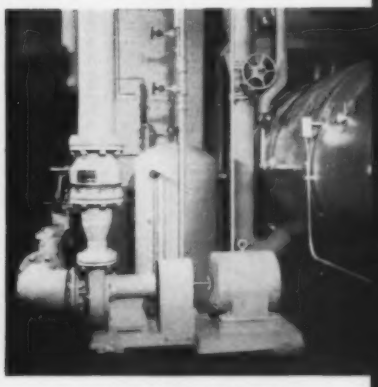
Cooling Towers



Exhaust Fans



Air Handling Equipment



Boiler Feed Water Pumps

Duty Master: electrical stamina—mechanical strength

The pictures of other installations tell the story of Duty Master's full-system service. Vitally important is the Hermetic Lecton*-insulated Refrigeration Motor, driving a centrifugal compressor. It repels freon, oil, water and heat... retains dielectric strength and resists flaking. Cuts maintenance and uncomfortable down-time. Accelerated 5-year tests show no insulation deterioration or breakdown, even when motor is operated continuously at 300°F! It's available from 10 to 1000 hp.

In other applications shown, the quiet Duty Master does a competent, uninterrupted job. It is not affected by dust, dirt or moisture. Multiple-dipped insulation, plus metered lubrication system (Metermatic) give you the built-in protection so necessary for efficient operation. Maintenance is at a minimum.

For special applications, such as gas absorption systems, the Reliance Submersible Motor can be safely immersed in water, oil, or liquid chemicals, in this case lithium bromide. Exclusive Reliance "Liqui-Seal" construction seals oil in, foreign contaminants out.

Reliance gives you a wide variety of modifications for any air conditioning application . . . pump-mount adaptors, vertical NEMA C-Face and D-Flange motors, P-Base motors . . . in all enclosures. Duty Master A-c. Motors are now available, ready to ship, in 1 through 250 hp. ratings.

Your nearest Reliance Sales Engineer or distributor can show you why the Duty Master line is so completely suited to your air conditioning requirements. Call him. If you choose, write for detailed information—Bulletins B-2507 and B-2505.

B-1649

*DuPont Registered Trademark

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 362A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities

Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

Steel pipe was first choice at Travelers Insurance Company after performance/cost actuarial tables showed the facts

Evaluated on the basis of performance, service life, original cost, installation cost—calculation showed that *steel pipe* could best serve the new Travelers Life Insurance building in Boston for vent and drainage lines, the fire protection sprinkler system and stand-pipe fire lines.

The cost of *steel pipe* when related to the performance advantages was truly significant. And, the savings in initial cost and installation cost were considerable. But these facts are true in most *steel pipe* applications . . . for *steel pipe* is the least expensive and most versatile of all tubular products.

These are the reasons why *steel pipe* is the most widely used pipe in the world for fire sprinkler systems, water transmission lines, vent and drainage lines, structural applications, radiant heating, snow melting, refrigeration, ice making, gas, and air lines, and for electrical conduit.

Simple equipment and tools make steel pipe easy to install anywhere.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U.S.A.

COMMITTEE ON STEEL PIPE RESEARCH

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New from American-Standard
Industrial Division

Air-Lift† for modern buildings

Air-Lift is a new concept of coordinated products and services from American-Standard Industrial Division. Its purpose is to help you lift the efficiency of modern buildings through better control of indoor climate. Air-Lift offers you one-source responsibility for air conditioning, heating, and ventilating equipment that is designed, engineered, and manufactured to a uniform standard of quality and performance.

To see how Air-Lift can benefit your building . . .

← LIFT THE FLAP

†Service-mark of American-Standard

AIR C

Centrifugal Refr
Station Air Cond
Room Fancoil U
Zone Air Conditi
fiers • Air Washe
Air Conditioners
Pressure Fans

VE

Centrifugal Fans
Power Roof Vent
Fans and Blower

One-source responsibility

The heart of American-Standard Industrial Division's Air-Lift Service

Now . . . with the combined American Blower, Ross Heat Exchanger, and Kewanee Boiler product lines . . . American-Standard* Industrial Division offers *all* the major components for complete, integrated air-conditioning systems.

You benefit by getting heating, cooling, refrigerating, and ventilating equipment designed, engineered, and manufactured to work together. And—most important—you have one-source responsibility for its quality and performance.

Offices in all principal cities are staffed by product specialists whose practical knowledge of the selection and application of air-conditioning equipment may prove most helpful to you. May we serve you? AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICHIGAN. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO. EXPORT DIVISION, AMERICAN-STANDARD, NEW YORK CITY.

Products designed, engineered, and manufactured to work together

CONDITIONING

Refrigerating Machines • Central-
Conditioners • Package Water Chillers
il Units • Induction Units • Multi-
nditioners • Sprayed Coil Dehumidi-
shers • Cooling Coils • Self-Contained
ners • Cooling Towers • High-
s

HEATING

Firebox, Scotch-Type, and Package Boilers
Steam, Hot-Water, and Gas-Fired Unit Heaters
Heating and Ventilating Units • Heating Coils
Cabinet Heaters • Industrial Heaters

VENTILATION

Fans • Propeller Fans • Axial Fans
Ventilators • Utility Sets • Specialized
owers

SERVICE-WATER HEATING AND FLOW CONTROL

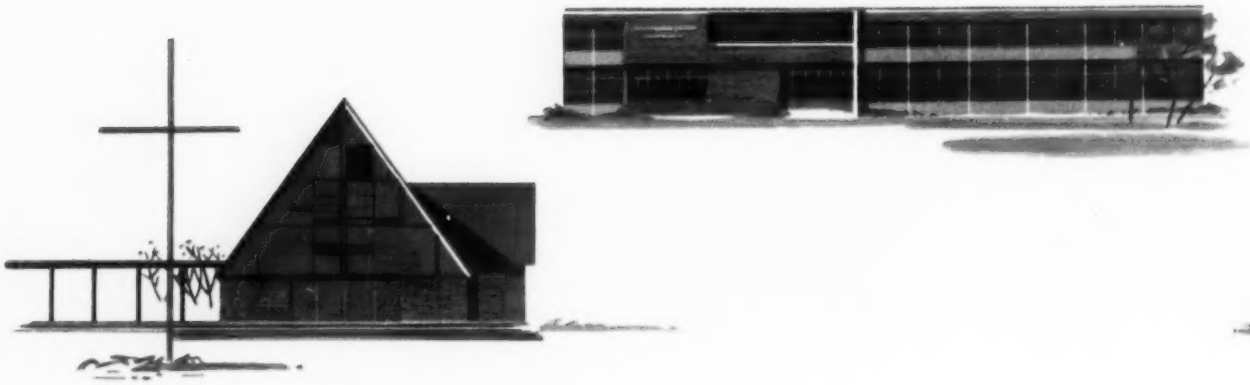
Instantaneous Water Heaters for service-water, booster, or convertor duty • *Gyrol*® Fluid Drives to drive water-service pumps—eliminate compressed-air system or roof tank

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
INDUSTRIAL DIVISION

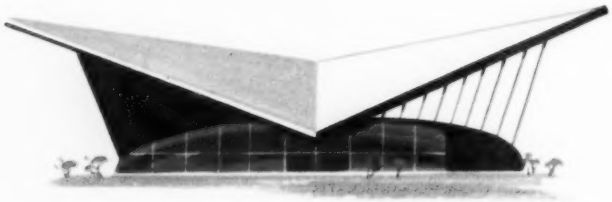
AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

American-Standard Industrial Division AIR-LIFT IN ACTION



An indoor climate as modern as the build

with systems or components from



COPYRIGHT 1959, AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

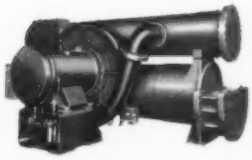
ilding itself,
n a single source

Because new ideas in building design win acceptance by working better, providing more in comfort and convenience . . . air-conditioning systems must be as modern as the buildings they serve. This is the reason for Air-Lift.

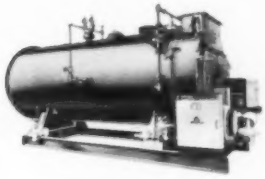
With thousands of installations in all manner of structures—towering office buildings, sprawling shopping centers, hotels, motels, auditoriums—American-Standard Industrial Division has a comprehensive knowledge of air-conditioning problems. And, with a complete line of coordinated products for air conditioning, heating, and ventilating—American-Standard Industrial Division offers *all* the equipment for efficient climate control in any building.

Air-Lift can work for you. Call on us.

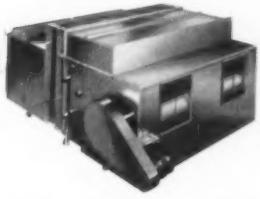
Select by the piece—
buy by the package



Centrifugal refrigerating machines for central-station air conditioning.



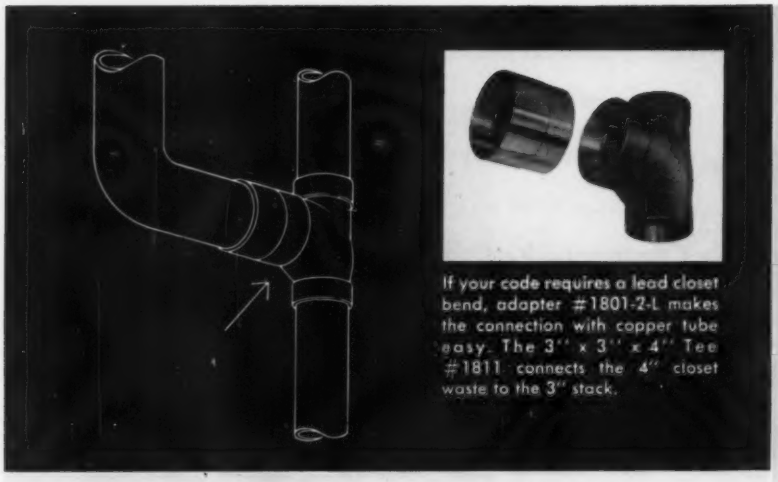
Firebox, scotch-type steel boilers and package units for heat, steam.



Central-station air conditioning units for public buildings, plants.

Centrifugal fans for high-pressure air conditioning, ventilating.

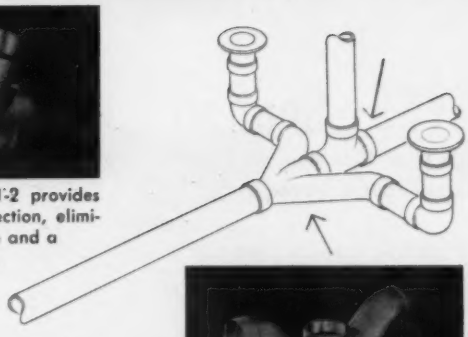
Self-contained air conditioners, air- and water-cooled types.



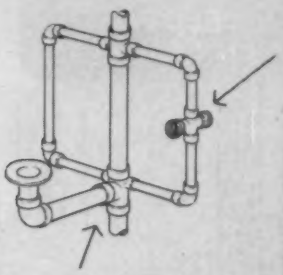
If your code requires a lead closet bend, adapter #1801-2-L makes the connection with copper tube easy. The 3" x 3" x 4" Tee #1811 connects the 4" closet waste to the 3" stack.

For back-to-back waste lines, fitting #1835-3-3 lets you install threaded nipples prior to plastering.

Sanitary Tee #1811-2 provides fitting-to-fitting connection, eliminating a short nipple and a soldering operation.



Double long turn T-Y #1836 eliminates the double Y-branch and 45° elbows combination.



Here's new time-saver—required by some codes — #1870. Note center line of side inlets is above center line of the main 3" inlet.

A FEW TYPICAL EXAMPLES OF TIME-SAVING ANACONDA FITTINGS

THERE IS A "RIGHT" ANACONDA FITTING FOR EVERY CONNECTION. With solder-joint fittings, a copper tube drainage system is roughed in quickly and easily—even when the work is overhead or in tight quarters. And there are many Anaconda fittings that save you still more time, effort and cost because they eliminate the need to assemble several fittings or a combination of fittings and short nipples. Do you have our *Catalog C-12* "Anaconda Copper Tube Fittings and Valves"? Every size (from 3/16" through 12") and type you need for general plumbing, heating, air-conditioning and refrigeration is listed for ready reference and ordering. Write: The American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5909

ANACONDA® **COPPER TUBE AND FITTINGS for soil, waste and vent lines**

Available through plumbing wholesalers. Products of The American Brass Company

Longer Lengths—Fewer Joints

Preassembly—Saves Time

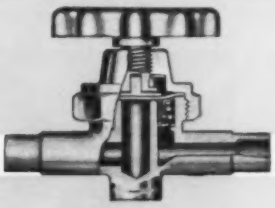
Lightweight Copper—Easier Installation

Compact Connections—Save Space

HENRY VALVE CO.

CONTROLLING FLOW SINCE 1914

Every product bearing the name Henry carries with it complete assurance of on-the-job satisfaction. This quality of performance and the confidence it inspires have made Henry the most accepted line in the industry. For Commercial Refrigeration and Air Conditioning Systems Using Refrigerants 12, 22 and Ammonia.

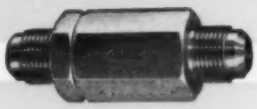


VALVES—Shut-off

Packless, Packed and Wing Cap Types
Integral and Flanged Connections

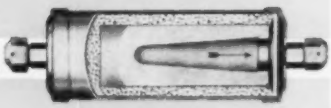
VALVES—Pressure Relief

Piston and Diaphragm Types for Atmospheric and Vent Line Applications



VALVES—Flow Check

Spring Loaded and Free Floating Types—also for water and air



FILTER-DRIERS & Driers

DRI-COR Sealed and Cartridge Types with Molded Core and Granular Desiccants

STRAINERS—All Types

Sealed and Cleanable—Applicable for water, oil and air

Also: Tube Piercing, Line Tapping, Line Port and Can Tap Valves
Strain-O-Kaps and Terminal Seals for Hermetic Compressors

HENRY VALVE COMPANY

For Refrigeration, Air Conditioning and Industrial Applications

MELROSE PARK, ILLINOIS, U.S.A. CABLE: HEVALCO, MELROSE PARK, ILL.

Death of a snowflake

Pity the luckless snowflake that lands on a sidewalk, when lying-in-wait, 3½ inches below the paved surface, is the dreaded enemy of all snowflakes—a modern steel pipe snow-melting system.

These systems spell instant death for all snowflakes. And, they're ideal for installation around office buildings, hotels, churches, theaters, bus terminals, airports and highway toll gates. When you're planning snow-melting systems, be sure to include USS National Steel Pipe in your plans.

For more than 60 years, National Pipe has been the consistent choice of architects, engineers and contractors for every type of tubular application. It's the largest selling pipe in the world. For more information, write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. *USS and National are registered trademarks.*

The world's largest and most experienced manufacturer of tubular products

National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

HUSKY

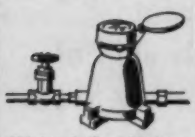
...new full-flow gate valve that throttles like a globe!

You've never seen a valve like this newly designed HUSKY conical gate. New shape, new closure principle that provides unrestricted flow, but can be throttled from shut to wide open. And, there's practically no wear out. These new HUSKY features, together with its low price, permit contractors to greatly upgrade all installations. Presently available at wholesalers in ½" and ¾" sizes (solder end or threaded).

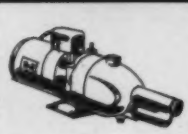
FEATURES

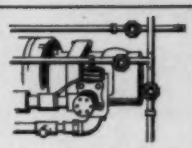
Hexagonal Body • Concave Seat • Buna-N Gate • W. O. G. • Non-Rising Stem • Full Flow • Throttle Control • Aluminum Handwheel • Fingertip Closure Only Seven Parts

UNIVERSAL USAGE!


Water & Gas Meters

Radiators


Water Pumps


Air Lines

Fuel Supply
...and many others

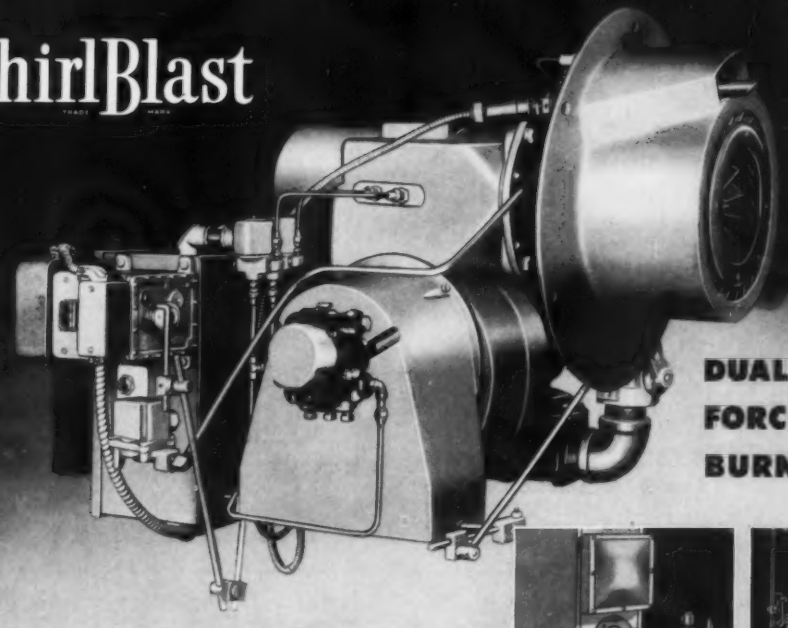
HUSKY
BRASS VALVES

NIBCO INC.

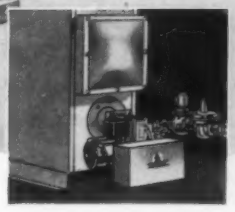
NIBCO INC., Dept. K-6402
Elkhart, Indiana

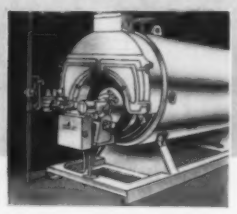
A new development by Iron Fireman

WhirlBlast



DUAL FUEL FORCED DRAFT BURNER





Makes firebox boilers super-efficient

NO SMOKE

Burns clean in less than 10 seconds. The WhirlBlast flame is brilliantly clean almost instantly, and stays clean. Although accepted standards of oil firing allow a 15 minute warm-up period, during which time smoke is tolerated, the Iron Fireman WhirlBlast burner is clean in seconds. Smoke and soot are unburned fuel—completely wasted by smoky starts.

NO STACK

Needs only an exhaust vent. Boilers with conventional burners require from 30 to 80 feet of stack or an induced draft fan. Sealed steel firebox boilers with WhirlBlast burners require only a small exhaust vent.

CONSERVES BOILER HEAT

Standby loss is almost nil. The highly efficient WhirlBlast burner does not need a refractory combustion chamber to "support combustion." Consequently there is no brickwork to store heat to be wasted during "off" periods. Standby heat loss is reduced to an insignificant minimum.

CUTS COSTS

Low fuel bills; low maintenance. Efficient combustion and low standby loss conserve fuel. Elimination of smoke and soot means no fouled boiler tubes, no carboned nozzles or electrodes; no refractory maintenance expense.

A COMPLETE PACKAGE

No special skill to install, adjust, service or operate. The WhirlBlast burner (for gas, oil or dual-fuel combination) comes from the factory fully wired and tested. Bolts to boiler front with firing head through fire door. No special combustion chamber or firing pit needed. Exceptional installation saving.

Send coupon for further information.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT
FOR HEATING, POWER, PROCESSING

IRON FIREMAN MANUFACTURING COMPANY
3093 W. 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send me more information and specifications on the Iron Fireman WhirlBlast burner.

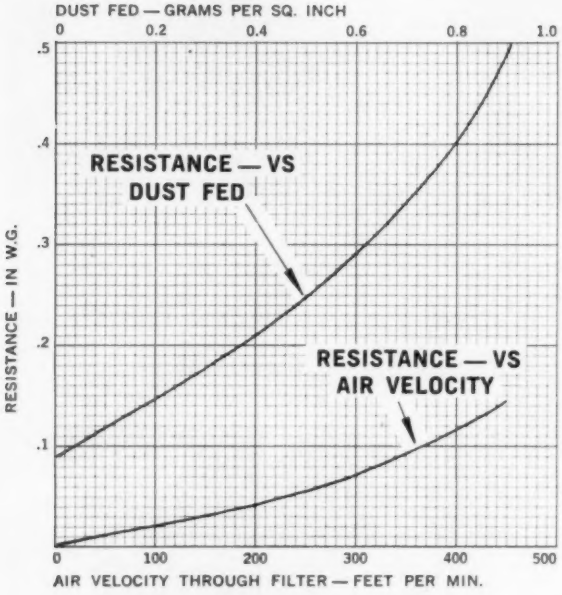
Name .....

Firm .....

Address .....

City ..... Zone ..... State .....

New FRAM® permachem-treated add a totally new dimension to air cond

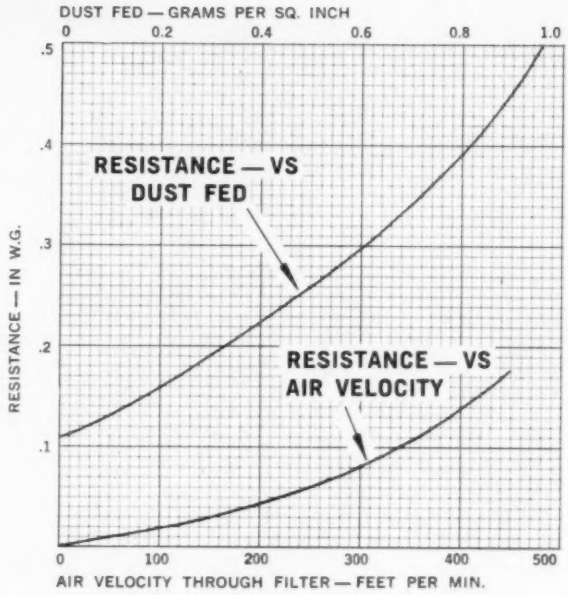


Contaminant Efficiency and Capacity Test
FRAM permachem-treated Air Filter
1" DISPOSABLE (DRY TYPE)

TEST CONDITIONS: (FRAM Procedure #955)

1. Resistance vs. Dust Fed determined at constant air velocity of 350 F.P.M.
2. Contaminant Feed Rate is .0185 grams per min. per sq. inch. Contaminant is standard A.F.I. Test Dust consisting of
   72% Fine Air Cleaner Test Dust (Road Dust)
   3% Cotton Linters Wiley Mill Ground (Lint)
   25% K-1 Carbon Black (Soot)

TEST RESULTS:
Efficiency — 65.7%
Dust Holding Capacity — .59 grams per sq. inch



Contaminant Efficiency and Capacity Test
FRAM permachem-treated Air Filter
2" DISPOSABLE (DRY TYPE)

TEST CONDITIONS: (FRAM Procedure #955)

1. Resistance vs. Dust Fed determined at constant air velocity of 350 F.P.M.
2. Contaminant Feed Rate is .0185 grams per min. per sq. inch. Contaminant is standard A.F.I. Test Dust consisting of
   72% Fine Air Cleaner Test Dust (Road Dust)
   3% Cotton Linters Wiley Mill Ground (Lint)
   25% K-1 Carbon Black (Soot)

TEST RESULTS:
Efficiency — 71.1%
Dust Holding Capacity — .68 grams per sq. inch.

These and other Original Equipment Manufacturers now bring you the remarkable air-cleaning action of new FRAM permachem-treated Air Filters . . .

Industrial Division
FRAM permachem treated Air Filters will be available in 1960 central station air conditioners.
Coleman
Furnaces
FRAM permachem treated Air Filters will be original equipment in all 1960 residential forced air furnaces.
KRITZER PRODUCTS
PEERLESS OF AMERICA, INC
FRAM permachem treated Air Filters will be original equipment in all 1960 COMBINEX Heating and Air Conditioning Fan Coil Units.
TRANE
FRAM permachem treated Air Filters will be available in 1960 models of Unit Ventilators, furnaces, Unitrane, Packaged Air Conditioners and Central Station Units.
TYPHOON
FRAM permachem treated Air Filters will be original equipment in all 1960 Self-Contained water cooled and air cooled; Remote water cooled and air cooled air conditioners — from 3 through 75 tons.

Air Filters kill 99+% of germs trapped... itioning and forced air heating systems

Now . . . for the first time ever . . . you can specify filters for air conditioning and forced air heating systems that not only trap dust, dirt, pollen and other airborne pollution . . . but also *kill 99+% of germs trapped in the filter!*

Only new FRAM permachem-treated Air Filters offer you this remarkable germ-killing action. Here's why. These revolutionary new filters are treated with *permachem* — a hospital-proved germicidal chemical that lasts for the entire life of the filter. Result: germs trapped in the filter are destroyed . . . air is kept hospital clean!

That's one reason why leading Original Equipment Manufacturers select new FRAM permachem-treated Air Filters for their 1960 central systems. These manufacturers also find that new FRAM permachem-treated Air Filters offer:

1. LONGER LIFE — Scientifically-blended acetate fibers provide full-depth filtration . . . give 12 to 46% longer filter life, according to direct comparative tests!

2. BIGGER CAPACITY — New FRAM permachem-treated Air Filters trap bacteria, pollen, dirt, smoke, airborne pollution . . . hold up to 34% more dust in direct comparative tests!

3. DRY-FILTER DESIGN — These remarkable new filters do not use oil . . . cannot clog ductwork, stain walls and ceilings!

4. MAXIMUM FILTERING SURFACE — New FRAM permachem-treated Air Filters have metal backing on just *one* side . . . give most effective filtering surface of any filter!

5. STRONGER CONSTRUCTION — These rugged new filters have unique single-unit, anchor-locked frames . . . media cannot settle, vibrate, blow or soak loose!

6. SOFT, SAFE MEDIA — New FRAM permachem-treated Air Filters have a media that's pleasant to handle . . . nonirritating . . . nonhazardous!

Wide choice of sizes. New FRAM permachem-treated Air Filters are available in sizes and types to fit *all* air conditioning and forced air heating systems that use standard velocity, disposable-type filters.

FRAM offers you specification help, too. FRAM Aire now has service representatives and distributors in all parts of the country to help you. Contact your local FRAM Aire distributor now, or write directly to FRAM Aire. Be sure you get your free copy of the technical manual on FRAM permachem-treated Air Filters.

UL

Guaranteed by Good Housekeeping

Westinghouse
Warm Air Furnaces
FRAM permachem treated Air Filters will be original equipment in all 1960 residential forced air furnaces.
WORTHINGTON
FRAM permachem treated Air Filters will be original equipment in all 1960 fan and coil room air conditioners. Also available on all 1960 induction circulators.
YORK
FRAM permachem treated Air Filters will be original equipment in all 1960 room air conditioners . . . available in 1960 Hi-I Induction Conditioners, Multi-Jet Induction Conditioners, Model CF Fan Coil Conditioners, and Central Station Air Conditioners.

FRAM *Aire Corporation* DIVISION OF FRAM CORPORATION, PROVIDENCE 16, R. I.

Figuring tubing materials on a cost per year basis?

NEW 4-D WROUGHT IRON costs less, lasts longer

The lower the cost per year, the more economical the investment. Especially so when the material lasts a long, long time. Take the cost comparisons below. Based on actual installations, users of wrought iron cold drawn tubing have been investing wisely for many years. Now, with new 4-D Wrought Iron available, your savings are even greater.

Note: New 4-D Wrought Iron was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

Result is *increased* corrosion-resistance, *improved* mechanical and physical properties.

INSTALLATION	COST PER FOOT PER YEAR	
	WROUGHT IRON	STEEL
Hotel, Brooklyn, New York Hot ammonia gas passing through interior of tubes, cooled by salt water circulating along outside of tubes.	$ .03 (19 years)	$ .24 (2 years)
Ice Company, Chicago, Illinois Carbon dioxide condenser service.	.03 (18 years)	.05 (10 years)
Film Corporation, Binghamton, New York Tubes used in cooling service.	.04 (15 years)	.06 (8 years)
Industrial Plant, New Bedford, Massachusetts Ammonia condenser with salt water in coolant.	.04 (12-14 years)	.48 (1 year)
Industrial Plant, Toronto, Canada Tube and shell type condenser used for cooling brine with ammonia.	.01 (50 years)	.07 (7 years)
Ice Company, Aiken, South Carolina Ammonia condensers with mild brine solution containing 76 ppm sodium chloride for cooling.	.03 (18 years)	.29 (2 years)
Ice Company, Rocky Mount, North Carolina Condensers with mild brine solution containing 75 ppm sodium chloride for cooling.	.07 (8 years)	.16 (3 years)
Industrial Plant, Wisconsin Vaporizers for production of butane and propane gas. Severe stresses created by wide temperature variances.	.28 (2 years)	.96 (6 months)
Oil Company, Long Island City, New York Cool, weak ammonia liquor cools hot, concentrated ammonia liquor coming from generator on the way to absorber.	.03 (20 years)	.07 (6-8 years)
Process Company, Detroit, Michigan Heat exchangers with ammoniated brine concentration of about 10% ammonia and salt almost to saturation point.	.08 (8 years)	.16 (3 years)
Gas Company, Brooklyn, New York Ammonia condenser with cooling medium of creek water contaminated by the refuse from several nearby industrial plants.	.05 (16 years)	.22 (3-5 years)
Alkali Company, Saltville, Virginia Heat exchanger carrying ammonia liquor that is subsequently cooled by surrounding water.	.05 (16 years)	.30 (6 mos.-3 years)
Industrial Plant, Chicago, Illinois Condenser tubes in absorption system. Ammonia inside the tubing is about 200°F. and water outside the tubes is about 40°F.	.09 (9-11 years)	.28 (3 years)
Electric Utility Company, Hunts Point, New York Gas cooler drawing water from East River in New York City.	.15 (8-9 years)	.45 (2-3 years)
Warehouse & Cold Storage Corp., Springfield, Massachusetts Ammonia condensers and direct expansion cooling coil.	.02 (30 years)	.04 (12 years)

"Cost per foot per year" figures are calculated from current prices of cold drawn seamless steel tubing (ASTM A-179) and cold drawn wrought iron tubing (ASTM A-382). Because of the many variables involved, costs for installation labor, maintenance and replacement are not included. If they were, wrought iron's low cost story would, of course, be even more impressive.

Details on any of the above installations furnished on request. Write for Wrought Iron Heat Exchanger and Condenser Tubing bulletin.

BYERS 4-D WROUGHT IRON

TUBULAR AND FLAT ROLLED PRODUCTS

A. M. BYERS CO., CLARK BLDG., PITTSBURGH 22, PA.

Corrosion costs you more than Wrought Iron

This simple trap operating principle provides the efficiency, dependability and freedom from maintenance necessary for the most profitable use of steam

When trap is first installed, the inverted bucket is down and the valve is wide open.

When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until —

Steam (light color) reaching the trap floats the inverted bucket and closes the valve.

When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

Key: condensate steam steam bubbles air bubbles

ARMSTRONG INVERTED BUCKET STEAM TRAPS

are designed and made to give you these big benefits:

● Amstrong Traps, the first inverted bucket steam traps, now represent the most advanced development of this time-proven principle. They provide all the advantages necessary for efficient, economical condensate drainage from virtually all types of steam using equipment.

1. *No steam loss* – Steam never reaches the orifice even when there is no condensate load.
2. *Automatic air elimination* – Vent in trap bucket passes air and other non-condensibles through to be discharged with condensate.
3. *No cooling leg required* – Condensate is discharged at steam temperature as fast as it reaches the trap because trap operates on difference in density between steam and water not on temperature.
4. *Operates on any back pressure* – Failure of one trap in system will not cause others to open because high back pressure does not affect an Armstrong trap other than to reduce capacity. As long as there is a pressure differential across the orifice the trap will close on steam and open for condensate.
5. *Unaffected by ordinary dirt* — Swirling action of condensate keeps dirt in suspension until discharged with condensate, prevents it from lodging in valve.
6. *Completely dependable* — Proved design plus the use of all stainless steel working parts assure continuity of service and length of service unmatched by any other trap.
7. *Big capacity in a small, economical package* — Armstrong design gives you the highest practical capacity for any given pressure. And remember, Armstrong capacity ratings are based on *hot* condensate at the *working pressure differential* stated, not on theoretical orifice capacities.

Further information on these advantages plus much additional information is given in the 48 page Armstrong Steam Trap Book. Ask your local Armstrong Representative or write direct.

860 Series for low pressure heating service.

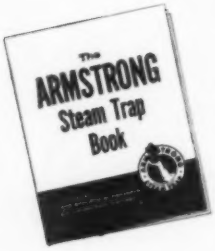
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

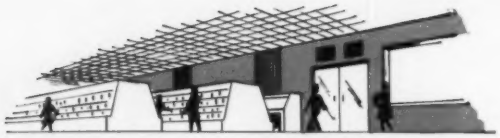


The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

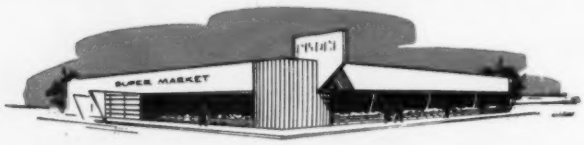
ARMSTRONG MACHINE WORKS

8743 Maple Street • Three Rivers, Michigan

"See our catalog in Sweet's Industrial Construction File."



INSTALL IT INDOORS



INSTALL IT OUTDOORS

The McQuay "AL" AIRCON air cooled condenser provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. You can utilize condenser heat for heating, and this AIRCON may also be used for exhaust ventilation, saving both time and money in installation, maintenance and operating costs.

"AL" AIRCON is compactly designed, and because of a very low silhouette, will not detract from the appearance of a building when roof mounted . . . the largest model is less than 4½ feet high, unnoticeable from the street.

"AL" AIRCON condensers are available in 8 different fan discharge arrangements and in 16 different unit arrangements . . . all standard. Each condenser coil is factory circuited in single or multiple sections to meet specific requirements of either air conditioning or refrigeration applications. Contact your nearest McQuay representative, or write McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.

utilize condenser heat with this low silhouette blower type

AIR COOLED **AIRCON**

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McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

IT MAKES SENSE !

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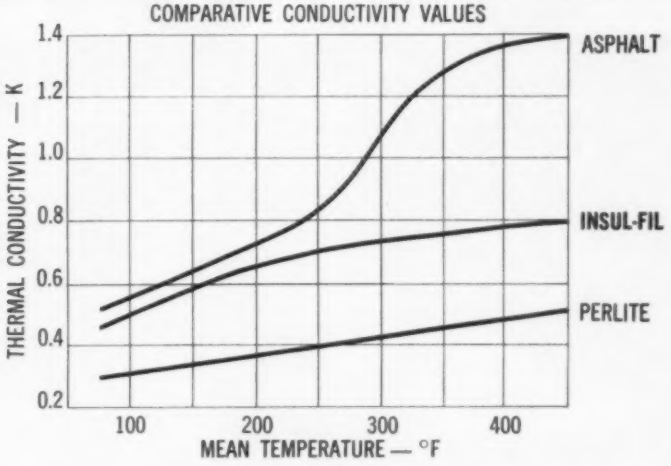
insul-fil®

1 Introduction of a material such as expanded perlite into a granulated hard asphalt improves the insulating value of the blend.

2 Proper selection of asphalts by softening point to make up asphalt-perlite blends improves the insulating properties of the blend.

3 Introduction of an aggregate, such as perlite, into a granulated asphalt improves the mechanical properties of the blend once it is plasticized.



After years of extensive testing conducted at the Research and Development Department of The Atlantic Refining Company, these conclusions were presented in a Paper given before the American Chemical Society in Dallas, Texas, April, 1956. Since that time, hundreds of Insul-fil field installations have confirmed these conclusions.*

It is a well-known fact that the use of asphalt in construction created the necessity for the introduction of fillers (usually inorganic) of various types for the purpose of arresting the flow characteristics and improving the insulation value of the asphalts themselves.

The blend of hard granular asphalt and asphalt coated perlite gives Insul-fil its excellent insulating properties, water resistance and sufficient structural strength to the insulating body to resist normal soil stresses with the steam on or off.

An important Insul-fil development is the priming of the pipe with Accelerator #7591. The use of accelerator provides continuous adhesion of Insul-fil to the pipe, hastens consolidation, and gives additional protection against corrosion by galvanic action.

**Paper available on request.*

Insul-fil Is Simple To Install

Just pour it around the pipe to be insulated. Prod and tamp it in place and backfill. Heat introduced into the pipe forms the conduit.

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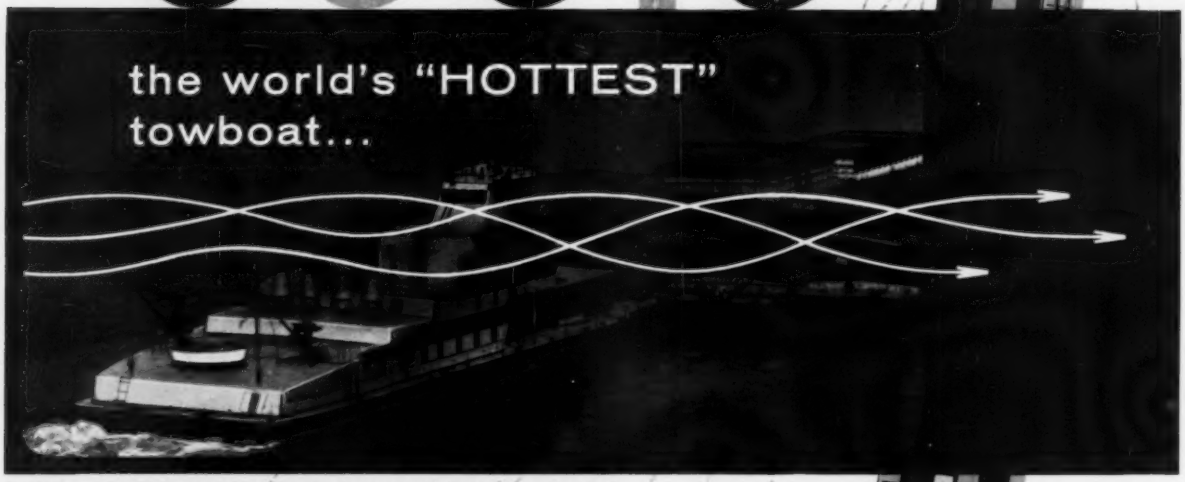
Curtis COOLS

the world's "HOTTEST" towboat...

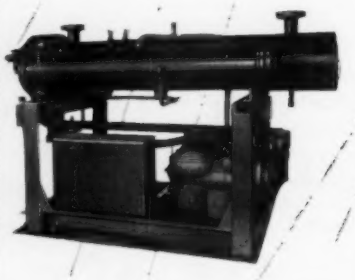


Huge 180 foot Federal Barge Lines towboat, the United States, has 50% greater horsepower than the largest towboat on the rivers. It can push 40 barges, totaling 1/3 mile, or 300 ft. longer than the "Queen Elizabeth".

C-100

Space saving design versatility? Easy installation? Operating dependability? Comparative cost? All these factors were considered by St. Louis Shipbuilding and Steel Company in the selection of air conditioning equipment for the world's most powerful towboat. The shipbuilders' and their design engineers' careful choice? A Curtis 20-ton packaged liquid chiller system. This equipment will cool the crew's quarters, galley, mess room, officers' and guest quarters—all with individual room or area temperature control.

The Curtis complete line, and reputation for dependability in installations of all types, work to the benefit of engineers and mechanical contractors. Factory run-in of all units cuts call backs far below average. You can safely promise dependable performance always up to, and frequently surpassing, rated capacity. You eliminate your problems when you specify Curtis, because you're working with an outstanding manufacturer of air conditioning equipment.

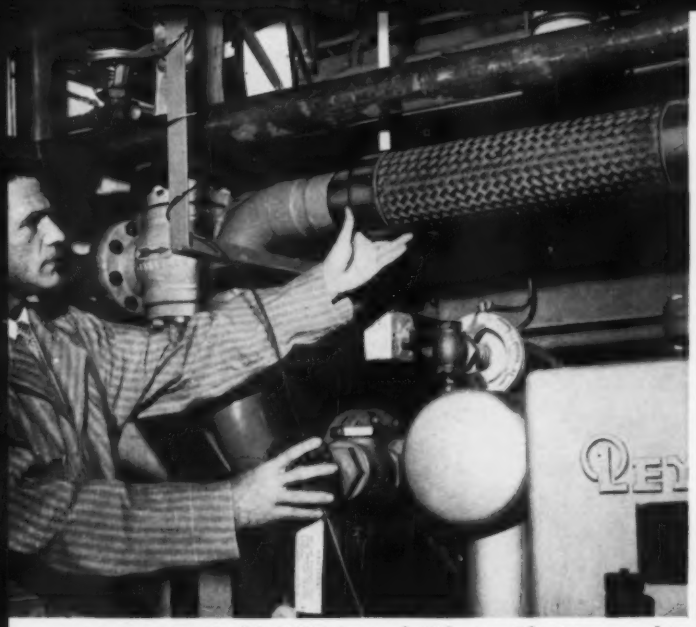


THE COMPLETE LINE OF LIQUID CHILLERS • PACKAGED AIR CONDITIONERS • CONDENSING UNITS

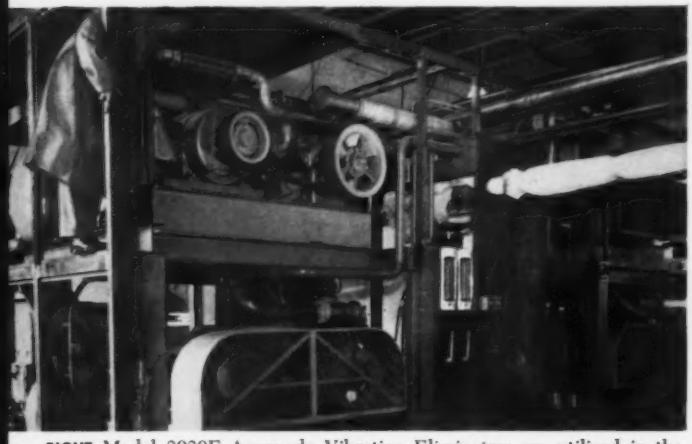
Curtis

ESTABLISHED IN 1854

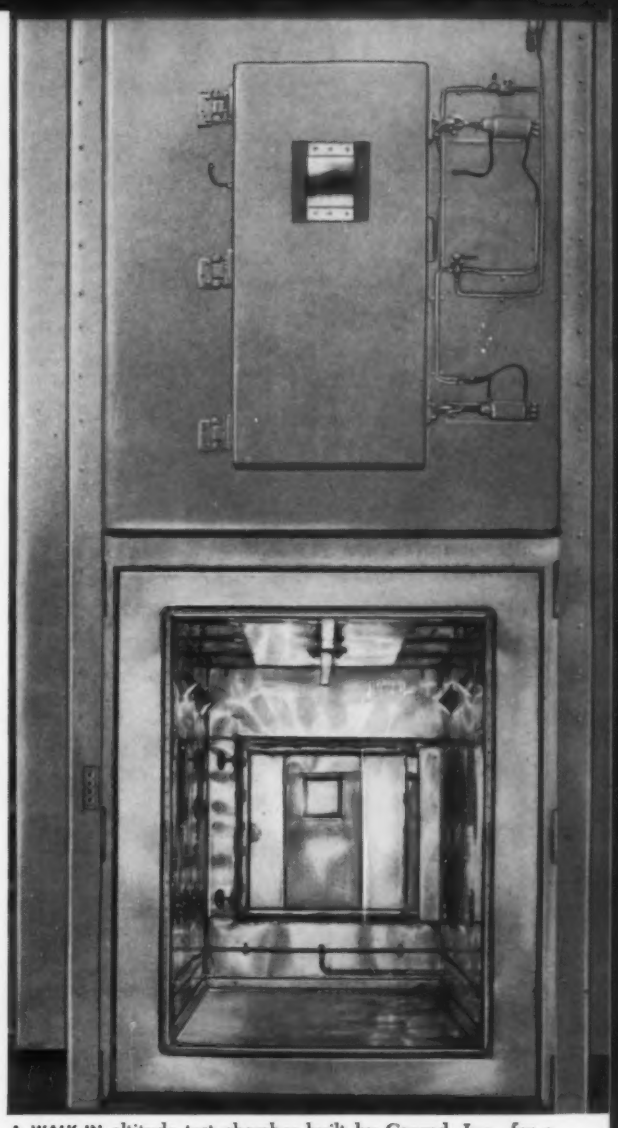
MANUFACTURING COMPANY • REFRIGERATION DIVISION • *St. Louis 33, Missouri*



ONE OF THE FOUR Model 4040F Anaconda Vibration Eliminators used in the vacuum system handling air under a vacuum of 3.5 mm. of mercury.



EIGHT Model 3030F Anaconda Vibration Eliminators are utilized in the Conrad cascade refrigeration system of four 50 horsepower compressors—two units with Freon 13 refrigerant maintain minus 120 degrees F., and two units with Freon 22 refrigerant cool the Freon 13 condenser.



A WALK-IN altitude test chamber built by Conrad, Inc., for a leading missile manufacturer. The 1200-cu. ft. chamber has a temperature range of 650F to minus 120F, can simulate altitude conditions from sea level to 120,000 ft.

To keep space-age test units working full time, Anaconda VE's guard refrigeration and vacuum lines

The extremely high cost of interrupted test schedules, if environmental test equipment fails due to cracked tubing from vibration, makes Vibration Eliminators excellent insurance. Conrad, Inc., environmental test chamber manufacturers of Holland, Michigan, designed and built the big chamber above. Anaconda Vibration Eliminators have been in use on Conrad test equipment for more than six years—have made a real contribution to dependable test equipment.

In air conditioning and commercial refrigeration, too, the cost of failures from vibration-caused tube cracking can run high, in reduced business volume, and loss of perishables. Why take chances with your customers' money—and your reputation? Use Anaconda Vibration Eliminators in every job. They're good business insurance.

VE'S ARRIVE CLEAN, READY TO USE—They're sealed in polyethylene envelopes or protected with end caps—packed in sturdy, easily identified boxes. When you open the package, your quality VE's are factory-fresh—clean inside and out—ready to install in the lines.

Listed by Underwriters' Laboratories through sizes $3\frac{5}{8}$" O.D. For descriptive folder write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

59149

ANACONDA®
VIBRATION ELIMINATORS

It would have been a tough insulating job ... except for G-B SNAP*ON®

You save all kinds of time and money when you insulate "hard-to-get-to" pipe with G-B Snap*On, the one piece pipe insulation molded of fine glass fibers. It's easy to carry 3-ft. G-B Snap*On sections to the job—even if you have to crawl or climb there . . . and they snap on pipe in one easy motion. No worry about breakage, for rough treatment won't harm G-B Snap*On. It's safer, too, because workmen can concentrate on their footing—and forget about dropping the insulation!

Add to these advantages the unequalled ease and economy of applying G-B Snap*On on straight runs, its superior thermal efficiency and permanence —and you can readily understand why G-B Snap*On is industry's No. 1 choice for heated or cold lines. It's available plain or with a variety of jackets, in sizes from copper tubing to 36", so there's a size and type just *made* for your next job!

FOR INFORMATION AND PROMPT DELIVERY
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Thermal and acoustical glass fiber insulations . . . Molded glass fiber pipe insulation
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NEW!

QT
SOUND CONTROL CURB

JENN-AIR

Reduces sound power 90%

for whisper-quiet efficient power exhauster ventilation

● After years of intensive research, Jenn-Air is proud to announce the QT SOUND CONTROL CURB—**the most important noise control development in power exhauster history!** Jenn-Air QT SOUND CONTROL CURBS absorb 90% of an exhauster's inlet sound power . . . while maintaining air moving efficiency at better than 90%. Verified by independent laboratory tests, this amazing performance gives you the long-sought key to practical noise attenuation. Check with your Jenn-Air representative for full details on how QT SOUND CONTROL CURBS can solve your ventilator noise problems.

● **The QT SOUND CONTROL CURB** absorbs, in just 10" of space, as much noise as 18 feet of lined duct 14" in diameter and 1" thick.

● **The QT SOUND CONTROL CURB** produces a speed reduction equivalent to 43% of actual speed . . . a 1725 rpm fan, for example, sounds as though it were turning at 980 rpm.

● **The QT SOUND CONTROL CURB** reduces a power exhauster's sone value (apparent loudness to the human ear) by approximately two-thirds.

● **The QT SOUND CONTROL CURB** offers effective noise control in an easily-installed, self-flashing, prefabricated curb.

Leader in functional IMAGINEERING . . .

Four sizes. Overall height is 10" or 11" mounted like a conventional curb with or without cant strip. Can also be installed into roof for lower contour.

Patent Pending

JENN-AIR

JENN-AIR PRODUCTS COMPANY, INC. • 1102 Stadium Drive • INDIANAPOLIS 7, INDIANA

Life in these excited states...

Corrosion is full of surprises

Out-guessing corrosion has been our business for 100 years. We now make 8 types of chemical resistant pipe . . . with valves, pumps, and tanks to match . . . and pretty well know what to expect with them. If anything, our advice is on the *safe* side. Please consult us with *any* problem.

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

Improved design . . . now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

World's best chemical valves . . . at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ⅛" pet cocks to 24" gate valves.

ACE processing equipment of rubber and plastics

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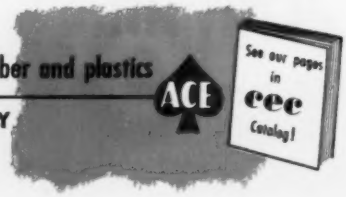
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey



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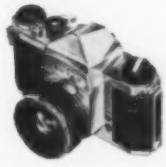
Use your professional skill in HONEYWELL'S BIG WIN-A-WAGON CONTEST!

You may win this authentic reproduction of a 1901 Olds—or one of ten Heiland Reflex Cameras!



Here's a real "stopper" of a car! This promotion-minded automobile is guaranteed to stimulate customer interest in your business! But whether promoting business or motoring the children, you'll find the "Merry Olds" to be the most unique innovation in motor car travel in half a century!

Simply estimate how many cycles Honeywell's new flame safeguard will make under rugged torture-testing. At press time, the safeguard has completed 94,560 cycles—equivalent to over six years of operation—and is still going strong! Then, submit your estimate on a post card along with your name, title, company and address. Kindly tell us whether you're an O.E.M., distributor, dealer (installer or serviceman) or a consulting engineer, and whether your prime interest is burners or boilers. Send your entry to Minneapolis-Honeywell, Dept. AC-2-40, Minneapolis 8, Minnesota.

- **FOUR RUGGED SILICON** diodes provide rugged construction
- **50% FEWER TUBES** in protective tube shields
- **SIMPLIFIED ELECTRONIC** timing
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Honeywell's new R478 Protectorelay* offers unmatched flexibility in a flame safeguard! Never before has one flame safeguard offered you so many applications and performance advantages: electronic flame detection, unparalleled sequencing flexibility, convenient voltage flexibility, simplified electronic timing and many other features!

*Trademark

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First in Control

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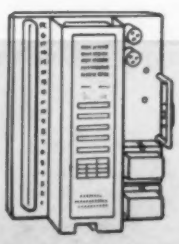

Matched control system for power gas burner

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Friendly Symbol of Fresh, New Service: Look for UCON IKE !

UCON IKE stands for America's newest refrigerants—top-quality UCON Brand Refrigerants. *Plus* a brand-new approach to service . . . backed by a published marketing policy.

You'll like the people who make this policy work for you. They're friendly, competent, imaginative people, who know and care about your problems.

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Something new for the air conditioning boys... and coils!

Now, Air Handlers from Halstead & Mitchell in 880 to 47,500 CFM Range

AH Series Air Handling Units

Before you buy any Air Handler, check and compare these new H&M units, feature for feature and price for price.

See how easily H&M Air Handlers accommodate matching cooling and heating coils, with space for up to 12 rows of coil depth overall! If you like, H&M coils (from 2 to 68 square feet of face area) can be factory-installed, leaving protruding connections on either side for easy hook-up. Halstead & Mitchell makes the coils you need to match: direct expansion, chilled water, hot water, standard or non-freeze steam. Filter sections are also available.

Performance? H&M Air Handlers deliver air against static loads up to 2-inches water gauge, and do it quietly.

Construction? They're the sturdiest units in the field. Forward curved centrifugal blowers are enclosed in a heavy gauge cabinet featuring formed steel corner posts and flush mounted panels.

Price? Just ask your H&M distributor. You'll be pleased. He has all the engineering information, too. Or, you can write for Bulletin AHU-100, Halstead & Mitchell, Bessemer Building, Pittsburgh, Pa.

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efficiently heat Winter Olympic Games dormitories

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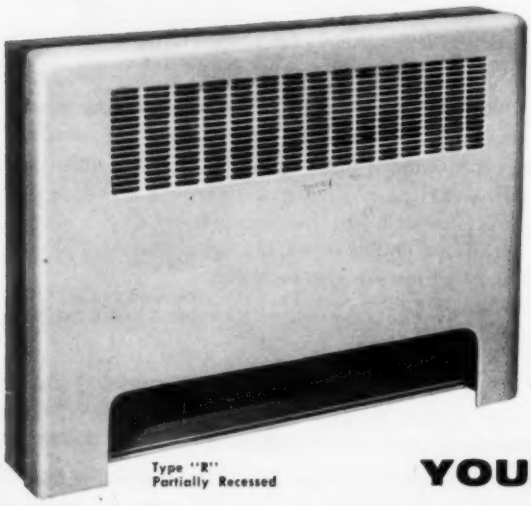

Type "R"
Partially Recessed

The world's greatest athletes from 34 nations will enjoy the warmth and comfort of the world's finest convectors. To provide the best in heating comfort over 400 Type "FS" sloping top free standing and Type "R" partially recessed Young Convectors were specified and installed in the four 3-story dormitories housing athletes competing in the Olympic Winter Games. These units efficiently heat every room in the four buildings . . . exceed the high quality standards required for this installation.

To get more details on the full line of Young Convector-Radiators, ask for Catalog 4059.

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Young *can solve your heating, cooling, and air conditioning problems . . .*

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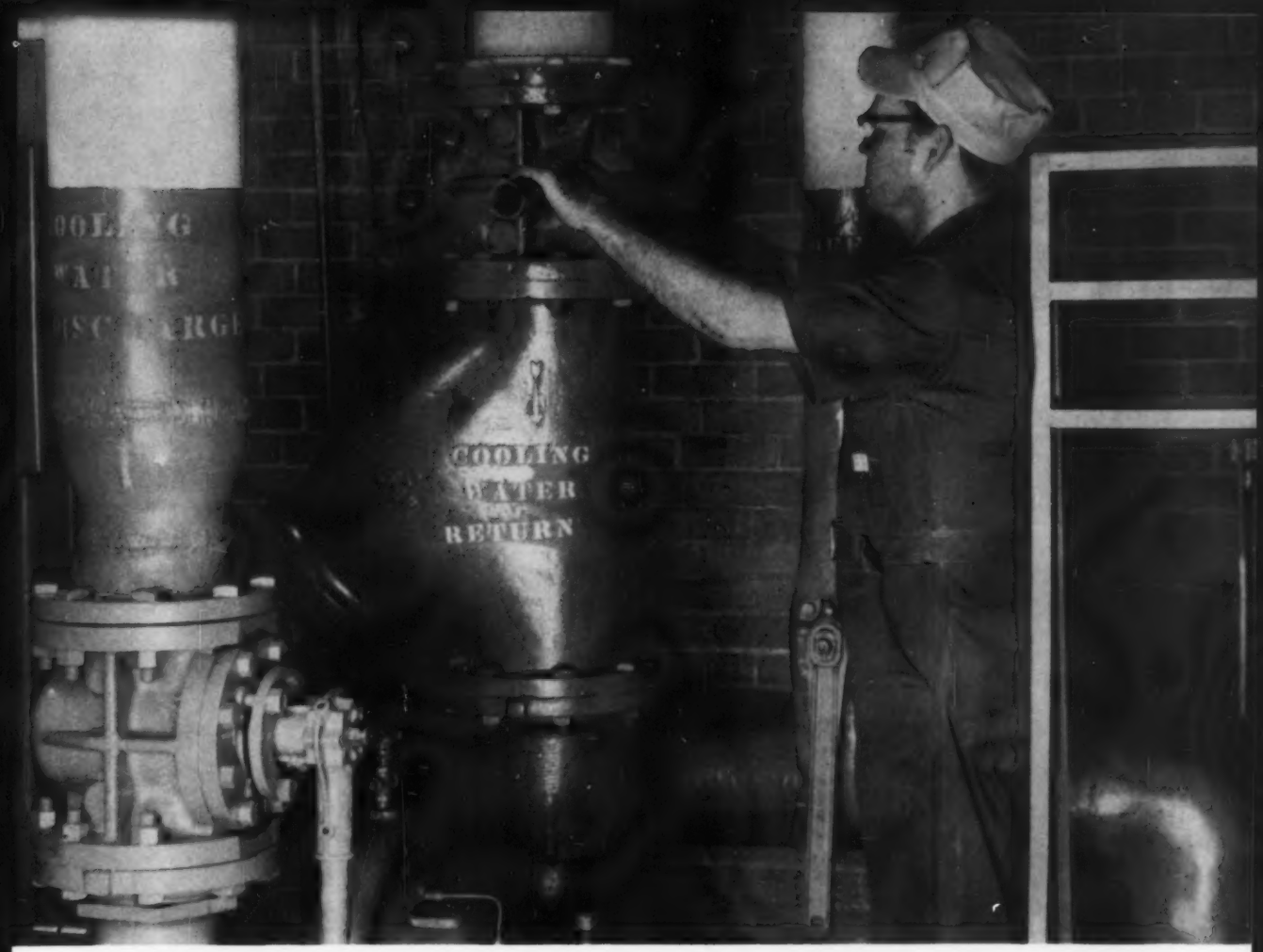
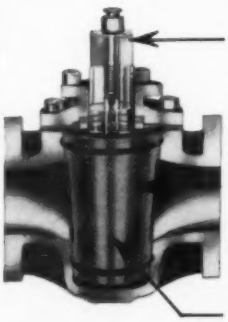


HOW ONE VALVE GIVES POSITIVE SHUT-OFF AND PRECISE SYSTEM BALANCING

SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

COMPACT: No bonnet cavity or rising stem saves weight and space.



PERFECT BALANCE: Plug is smoothly, easily positioned for precise throttling . . . wrench shows degree of throttle.

THROTTLE or SHUT-OFF: If desired, shut-off valve can be eliminated downstream from throttle valve. Positive shut-off assured by pressurized lubricant.

NO CHANCE OF NOISE: Solid tapered plug is perfectly seated in rugged body . . . no exposed seats . . . silent for the life of the building.

More and more air conditioning design engineers are specifying Rockwell-Nordstrom lubricated plug valves to get *both* positive shut-off and precise balancing with one valve. Since these valves are positively sealed by pressurized lubricant and they are easily positioned to give just the right degree of throttle it is easy to see why they've been used on so many of the new chilled water systems. Additional, important benefits of Rockwell-Nordstrom valves: *compact design* (no yoke or bonnet) to fit in tightest areas . . . *quiet operation* because flow through the valve is smooth, easy . . . and *long life* because it's a lubricated mechanism.

Why not get complete details on Rockwell-Nordstrom, the world's most complete line of lubricated plug valves, lubricants and accessories. Send the coupon below. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited. Rockwell International, S.A., Geneva, Switzerland.

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Another new development using

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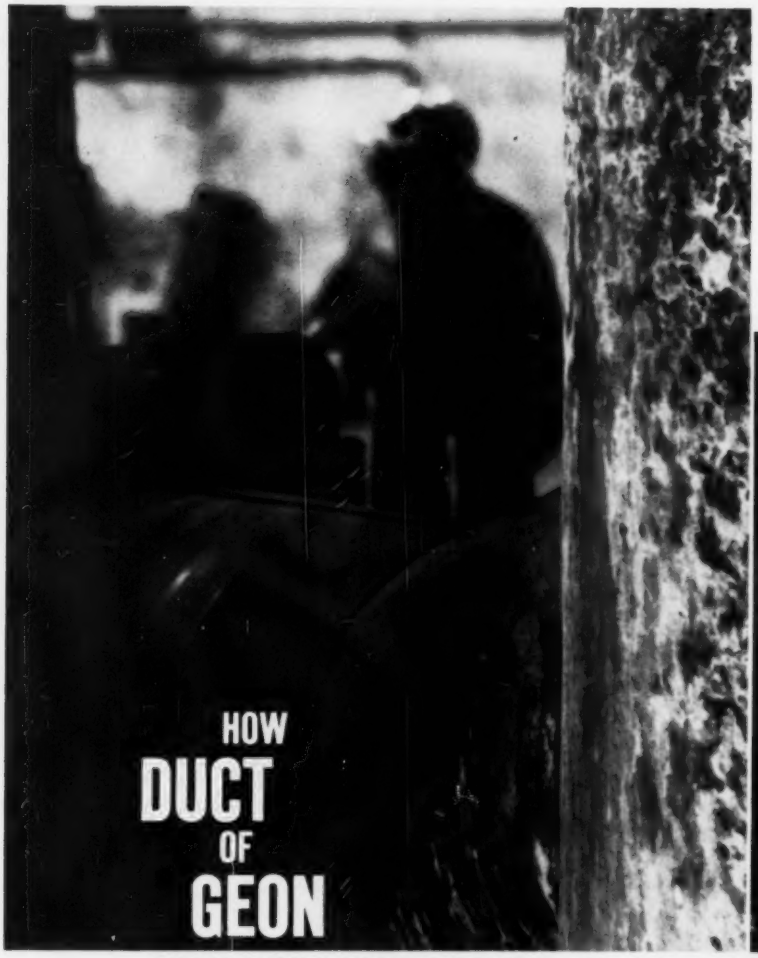
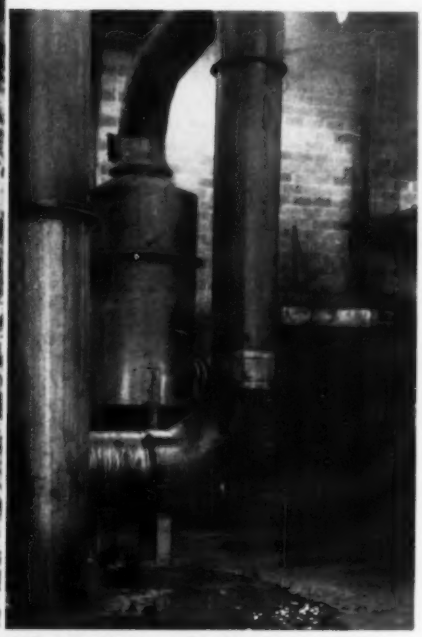


The large duct shown here was fabricated of Geon vinyl by Colonial Plastics Mfg. Co. through their distributor, Gould-Kramer, Inc., Cleveland, Ohio. B.F.Goodrich Chemical Company supplied the Geon vinyl.



CONQUERS CORROSION IN CHLORINATION ROOM

A tougher corrosion problem than this one would be hard to find. That's why all the large round duct you see is fabricated from rigid sheet made of Geon vinyl.

This room is where spent gases are carried from chlorinating operations to storage tanks. The atmosphere is such that personnel must wear goggles and face masks at all times. Corrosion would make short work of most ductwork or pipe.

But Geon is unaffected by acids, oils or many hydrocarbon chemicals. It is easy to fabricate, light in weight, and simple to install. Duct, pipe—even complete fans and valves—made of Geon are solving corrosion problems throughout industry.

For more information on products made of Geon vinyl—or on this versatile material itself—write Dept. G G-1, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich

GEON vinyls • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

make it

SPANG STEEL PIPE

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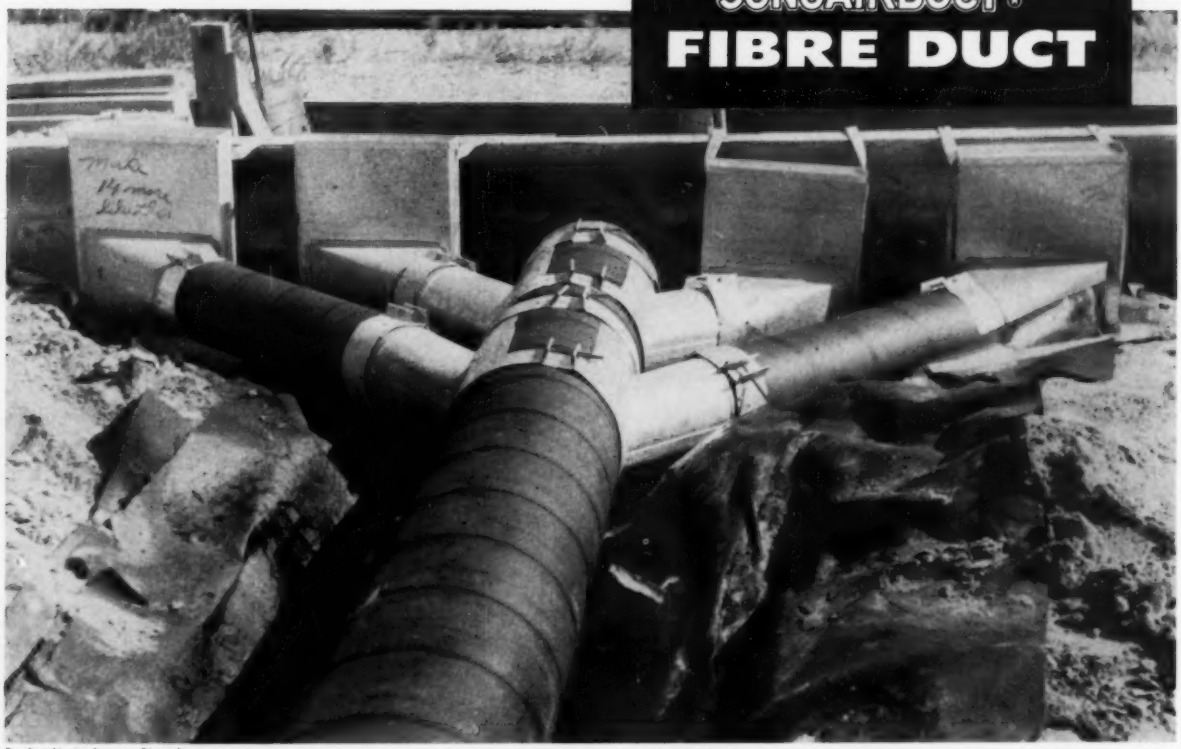

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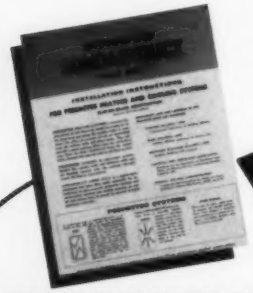

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Data File on Infrared Heating Will Clarify Many Questions of Engineers

I FOUND the design procedures suggested, as well as the general discussion of high intensity radiant heating in the HPAC Engineering Data File, *High Intensity Infrared Radiant Heating* (November 1959), most constructive. This information so excellently organized will certainly clarify many questions which confront heating engineers called upon to provide such equipment for open areas.

One of the few statements that might be amplified concerns the relative unimportance of the floor-reflected radiant energy as compared with the direct radiant heat intercepted by individuals in the irradiated area. While this is true, it is probable that in most semi-open areas the floor covering or surface apron will rise materially in temperature during periods of high intensity radiation, and such desirable effects are increased by surfaces of low heat capacity and local obstructions to direct outside air velocities.

Reradiation to the legs and body of long wave radiation, characteristic of this surface temperature, (contrasted with the minor reflectance of the direct high intensity beam), as well as reduced contact heat loss through the shoes, may be a significant heating effect. This effect will increase with length in the diurnal period of the primary heating and the degree to which the area is partially shielded from surface air velocities typical of a completely open area.

As a result of this factor, the black body temperatures as evaluated in adjacent areas, with and without high intensity radiant heating, should show a system efficiency somewhat greater than the percentage as evaluated by direct heat interception. The contribution of the low temperature surface radiation to this effect can be readily approximated by measurements on the black body when shielded from substantial surface effects by cone or hemisphere of reflective foil beneath the black body so arranged as to provide floor shielding without providing an important area in the line of sight of the high intensity heaters.

Design equations which permit the prediction of mean skin temperatures in seated subjects under wide variations of air and radiant temperature are now available.

Current studies will extend these to air movements other than the standard room condition and to different levels of activity.

L. P. HERRINGTON
Director of Research
John B. Pierce Foundation

Steps to Improve GM Plant's Air Supply Could Be Applied to Others

I HAVE READ the article, *Plant's Revamped Supply Air System Gives Workers Year 'Round Comfort*, by K. E. Robinson (January), with a great deal more than the usual interest. I'm sure others will share in this statement, since much of what the author describes in the article hits home. He has evidently experienced much grief in attempting to satisfactorily heat and ventilate a plant of this type with the system originally installed.

I'm sure Mr. Robinson will not hesitate to elaborate on a few points on which I would like a bit more information:

1) Am I correct in assuming that when the plant is not under full occupancy (as on week-ends) all recirculated air is used on the supply air systems?

2) Was the original "oil-curtain" type of filter re-used? Or was it replaced with another type?

3) What control is used on the steam coils in conjunction with the face and bypass damper control?

4) Is the controller for actuating the face and bypass dampers still located in the discharge air duct? Are there other controls?

5) Are the gravity type ventilators located at the

center point of the roof? Are they elevated on special curbs? If so, at what height are they? How long are the manually-controlled damper sections?

6) In selecting the outside air supply units at the outside walls and at the doors, what air flow rate is used? How are the units controlled? Are the units fitted with automatic outside air dampers for closure during fan *off* periods?

The approach Mr. Robinson has taken on this particular plant could well be applied to many "sick" plants. Certainly, worker complaints can be lessened or even eliminated and workers' efficiency increased.

H. P. KAULFUSS
Staff Engineer
Peoria Plant Engineering
Caterpillar Tractor Co.

THE AUTHOR'S REPLY—My answers to Mr. Kaulfuss' questions will have to be from memory.

1) On week-ends all recirculating air is used through the supply systems.

2) The original "oil-curtain" filters were re-used.

3) A modulating control is used to control the steam.

4) The control for the modulating valves is in the discharge air duct. There is now an electronic control system. All adjustments are made in the penthouse. A room thermostat resets the duct stat that, in turn, controls the temperature of the air as it is controlled by the face and bypass dampers and the modulating steam valve.

5) The roof is flat and the ventilators were laid out in an even pattern across it. The units are elevated on curbs sufficiently to allow the dampers to operate. I estimate the damper sections to be one-fourth of the total length of ventilator.

6) The air required to bring the building into balance was calculated and an attempt was made to distribute it evenly around the outside of the building. If I remember correctly, there was at least 10,000 cfm delivered at each door. The units are controlled by duct stats with modulating valves and, I believe, face and bypass dampers. Outside air dampers shut off the duct when the system is shut down.

K. E. ROBINSON
Ventilation Engineer
Industrial Hygiene Dept.
General Motors Corp.

Asks for Further Discussion on Unique Heat Reclaiming System

THE PROBLEMS discussed in the article, *Air-Starved Plants Can Breathe Easy Through Proper Makeup Ventilation*, by B. R. Small (October 1959), are familiar to all of us in the industrial air conditioning field. The article does a good job of reviewing these problems and discussing the conventional approaches to them.

From my own personal standpoint, I would have preferred a more elaborate discussion of the revolving wheel for heat reclaiming. This is touched upon only briefly on page 129. The article states that the first installation is now being put into operation in Iowa. I should like to have had a little more comprehensive discussion of this approach with respect to engineering design, approximate costs, space required, and other points that would make this approach more understandable from the application standpoint.

DE PARX STIMSON
De Parx Stimson Engineers

THE AUTHOR'S REPLY — The several questions asked by Mr. Stimson seem to be a little too broad for my article. Some form of heat recovery system will soon blanket those plants in northern climates where fuel is costly and winters are long and cold.

Much exhaust air is free of solids and condensibles and thus is suited to a direct contact heat storage type. On the other hand, corrosive gases and combustion product mixtures having low dewpoints probably require heat exchangers involving heat transfer. This subject could be developed into a noteworthy paper by someone with experience.

B. R. SMALL
Staff Ventilation Engineer
Aluminum Co. of America

Cites Two Design Considerations For Roof Spray Cooling Systems

IN COMMENTING on the article, *Roof Spraying Systems Offer Low Cost, Effective Relief from Summer Heat*, by W. O. Kind (January), I would like to mention two points which may be of interest to readers:

1) While the sun shines on a dry roof, its temperature is substantially raised above ambient. This causes heat to radiate into the building from the underside of the roof. As a result, in any one-story building (or top floor) with a dry roof, no matter how well insulated, the ceiling will all summer long be warmer than the walls and the floor. Whenever the ceiling temperature exceeds the human body temperature, this radiation causes discomfort to all occupants during the summer months.

Radiation on the head is an distressing as cold feet. Therefore, the air temperature as measured by thermometers hung at the 5 ft level in the conventional way is no indication of the thermal comfort condition. Placing a thermometer face-up to the ceiling will cause a substantial rise in its indication when the roof is dry in sunshine. This rise will disappear as the roof is cooled. In many cases the reading will even fall below that of the hanging thermometer.

2) With rare exceptions, water is hard to a degree and will precipitate calcium carbonates when warmed. Unfortunately, this precipitation is not a mud that washes away but is of crystalline structure. Crystal

formation needs a starting point and the crystal body attaches itself firmly to it. Therefore, since a roof cooling system gets warmer if the water flow stops, it will scale up unless it is drained upon every shutdown. To insure this, a three-way cock arranged to drain in the stop position can be used for the on-off control. Draining onto the roof, as mentioned in the article, can easily be avoided by placing all nozzles at the same level.

SIEGFRIED RUPPRIGHT
Professional Engineer and Consultant

Consulting Engineering Is High Risk Business Unless You Estimate Well

IN REFERENCE to the article, *A Consulting Engineer's Views on the Consulting Engineer's Responsibilities and Fees*, by Ralph M. Westcott (November 1959), I must admit that I am in agreement with most of the expressed thoughts.

I certainly agree that a consulting engineer is entitled to an honest profit. However, I believe a considerable number of consulting engineers are interested in profit only, honest or otherwise. I also believe the majority of consulting engineers are not good businessmen.

The consulting engineering field may be a high risk business for those of us that cannot analyze the scope of work or, after it is analyzed, cannot estimate our costs for the work. If one cannot evaluate the scope and cost of the work, he would be better off working for someone who can. There are too many cases of inadequate fees, whether they be arrived at knowingly or otherwise — all of which have tended to lower our fees. In so doing, we have also lowered the prestige of the consulting engineer.

There are times when it is necessary to reduce a fee below an amount which will return a fair profit. I believe most consulting engineers have been faced with this problem at some time or other. If this is the case—and it can be, for very legitimate reasons — the engineer is still obligated to provide the same quality services as he would if the fee were more in line. There are probably a few consultants that would accept gratuities or kick-backs from vendors in order to break even or to make a fair profit on their work. However, I have only known of one.

I believe most consulting engineers base their fees on percentage of construction cost. This is probably so, because the architect establishes his fee on the same basis. It is true that this method works against the engineer when he is compelled to spend more time in preliminary surveys, in cost estimates, and in design work to come up with the lowest possible cost for a system that is still feasible and practical and also will provide everything the client wants or expects. However, the young consultant just starting out and with no prior experience as to engineering cost can hardly use any other method. As long as his percentage is high enough, he most likely will make a profit.

Personally, I would rather evaluate the scope of the work involved, clearly define what services I intend to provide, and give the architect a lump sum fee. I realize that this is not always possible and it is necessary to resort to some other basis. But, in any case, I believe fees should be secondary once they are arrived at.

I do not believe reputable consulting engineers use rule of thumb methods or square foot basis as outlined in Mr. Westcott's article — at least not any that I know of. I would say that if this is true in some areas, then that particular area's professional engineer's society should take some action to remove such consulting engineers from practice.

I believe it is a good idea to listen to any contractor. In fact, my most valued experiences were gained while working for mechanical contractors. Without field experience I do not know how any consulting engineer can ever prepare a good set of workable drawings.

I believe that the consulting engineer, if possible, should be present with the architect on any negotiated fee. I do not believe that the architect — and I say this with all fairness — can possibly be aware of all the problems and the entire scope of work involved in every project. If the consulting engineer is present, he can advise the client of the actual scope and the services to be performed. He is in a better position to know if there is a possibility of a lower fee. This, I believe, is a necessity when negotiating a fee with the U. S. Government.

I certainly agree that quality work builds reputations. I do not believe one office can turn out a particular project any faster than another unless said office has specialized in a particular type of project. There are only a few places where time can be cut; namely, construction and typical details and coordination of the various trades. But if this work is left out, someone will suffer.

JOHN F. LAWRENCE
Counts & Lawrence
Consulting Engineers

Use of Insert Rings Should Not "Be at Fabricator's Discretion"

I AGREE with I. A. Rohrig's comments ("Open for Discussion," December 1959) on my article, *New Consumable Insert Ring Extends Use of Inert-Gas Tungsten-Arc Pipe Welding* (November 1959). He is correct in stating that the inert-gas tungsten-arc root-pass welding of chromium-molybdenum alloy steel piping can also be troublesome.

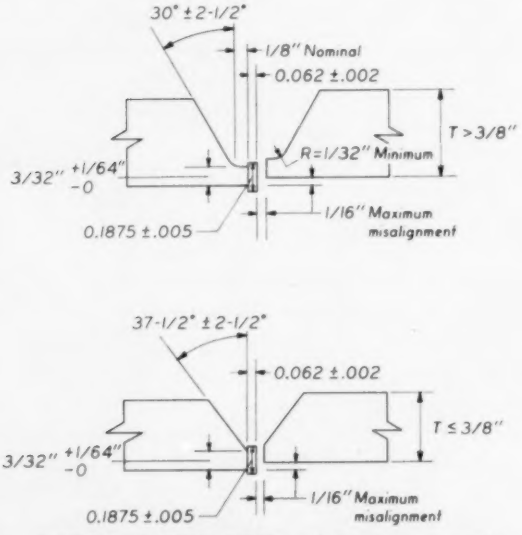
Because of better deoxidation of these steels (chromium itself being a deoxidizer) a sound root weld is

generally more readily obtained in chromium-molybdenum steel pipe than in carbon steel. Nevertheless, the use of consumable insert rings is recommended also for welding chromium-molybdenum steel piping. In chromium-molybdenum steel pipe welds, when such insert rings are not used, cracking may develop and may not be detected during routine visual inspection and radiographic examination of the completed weld.

Although a substantial number of engineering firms now specify the use of consumable insert rings, some leave the choice to the fabricator. Although extremely small in comparison to the cost of welding, these rings involve a cost item which the purchaser should be willing to absorb by specifying in the purchase specification that consumable insert rings be used.

Leaving the choice to the fabricator by stating in the bid specification "the use of insert rings is left to the discretion of the fabricator" would penalize the reliable fabricator wanting to produce weld joints of the highest quality, but whose price as a result might be slightly higher than that of another fabricator who is not as concerned with root weld quality and soundness. To be competitive, the "quality" fabricator would have to lower his quality standards somewhat by eliminating insert rings. If a service failure should develop, the purchaser would have been the loser, involving the cost of repair, replacement, and loss of production.

A typical example of the insert ring and joint setup requirements specified by a major engineering firm is shown in Fig. 1. The insert ring permits root gap and offset misalignment of 1/16 in. each. These tolerances, which cannot be readily welded on butt joints without insert rings, considerably facilitate root-pass welding and joint setup.



1 TYPICAL INSERT RING and joint setup requirements are pictured above. Rings must be of welding composition corresponding to piping material

Mr. Rohrig's discussion of the importance of proper welding equipment is well taken. Joint cleanliness is also important, since rust tends to cause porosity.

HELMUT THIELSCH
Metallurgical Engineer
Grinnell Co., Inc.

Queries Author on Points Covered In Hot Water Heating Articles

REGARDING F. F. Stevenson's article, *Now's the Time to Brush Up on Your Hot Water Heating Fundamentals* (September and October 1959), I pose the following questions:

1) Why should the number of radiators on a one-pipe system necessarily be limited?

2) Won't picking the right scale factor eliminate any chance of undersizing a converter?

3) Why should converters be supplied with steam at the pressure stated?

4) Won't a vacuum breaker solve the problems of low pressure in a steam coil?

Anonymous

THE AUTHOR'S REPLY — In reply to these questions, I submit the following:

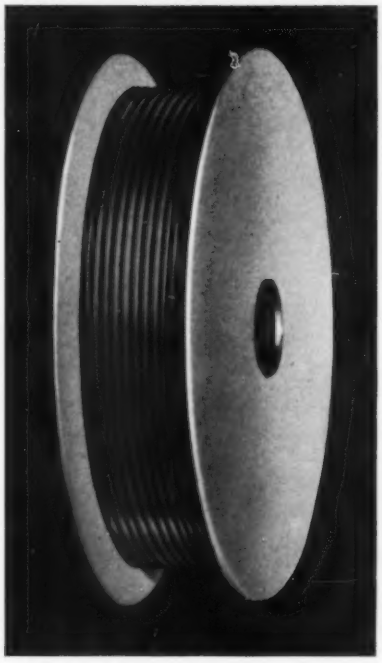
1) With an eight-radiator circuit, a 20 F temperature drop in each radiator, and assuming that 25 percent of the water in the main passes through each radiator, the temperature drop in the circuit (without counting the heat loss in the main itself) is 40 F. With the initial water temperature at 220 F, the final water temperature is 180 F. This is a temperature drop of almost 20 percent. Certainly, much larger radiators must be used toward the end of the circuit if design temperatures are to be maintained at peak loads. Therefore my statement that no more than eight radiators be used on each circuit still stands.

2) This confirms my statement that scale factors must be applied when figuring the tube surface required in hot water converters using steam.

3) The first reason for using higher steam pressures in convecters is to maintain a reasonably good temperature difference between water and steam. This is necessary because the temperature drop in a hot water converter is inherently low. The second reason is to maintain a satisfactory steam pressure into the converter, while taking a high pressure drop across the modulating valve — usually necessary for good operation and control.

4) The use of a vacuum breaker will not always provide 100 percent relief for a water-logged coil. It brings the coil pressure only up to atmospheric.

F. F. STEVENSON
Design Engineer



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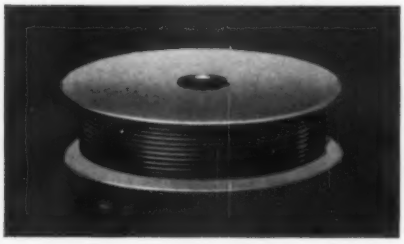

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question of the month

"What's Best Way to Join High Velocity Ducts?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other solutions or comments for publication are invited.

"What methods have proved to be the most successful for joining high pressure ducts? Ducts are galvanized steel and are spiral welded. Fittings are to be shop fabricated from 20 gage galvanized sheet metal. Static pressures will be from 6 to 9 in. WG.

"Is brazing the best method? If so, what brazing procedure may be used to prevent damage to the galvanizing?"—H. H.

Proper Installation Techniques Will Make Brazing Unnecessary

H. H.'s QUESTION regarding the brazing of high velocity ductwork brings back memories of the late 40's and early 50's. We were so impressed with so-called high velocity, high pressure air handling that we welded 16 and 18 gage ducts with joints flanged, gasketed, and bolted. From this extreme we have progressed to the modern-day dual-duct, medium velocity and pressure system. The specifications for one such installation are as follows:

"Medium and high pressure and velocity ductwork construction:

"1) The sheet metal gages shall be as follows:

Rectanguler side	Round	Gage
to 30 in.	to 29 in.	22
31 to 60 in.	30 to 39 in.	20
61 to 90 in.	40 to 49 in.	18
91 in. up	50 in. up	16

"2) Minimum joint connections and bracing shall be as outlined in Tables 9 and 10, pages 298 and 299, of the 1959 Guide, with additional bracing and stiffening as required by subsequent field tests and inspection.

"3) In general, the locking slips and joint seams shall be machine-made and sealed with adhesive cement prior to ductwork assembly. Standing seams and bar and pocket slips shall be button punched 5 in. on centers for their full length.

"4) All ductwork in this category shall be field tested in place at 8 in. water gage prior to installation of exterior insulation and/or finished enclosures. Lengths of ductwork tested shall be as dictated by field conditions. Allowable loss shall be a maximum of 10 percent by volume. Leaks shall be repaired by reworking joints or seams and/or sealing with adhesive cement.

"5) Round ductwork shall be joined by lapping in the direction of air flow and fastened with sheet metal screws through the lap plus a liberal application of adhesive cement before and after the joint is made."

This ductwork was field tested in place at 8 in. WG with very little reworking of joints. Joints tested in the shop checked out at 10 to 14 in. WG.

The adhesive cement used in sealing ducts is extremely important. Pressure tests must be conducted

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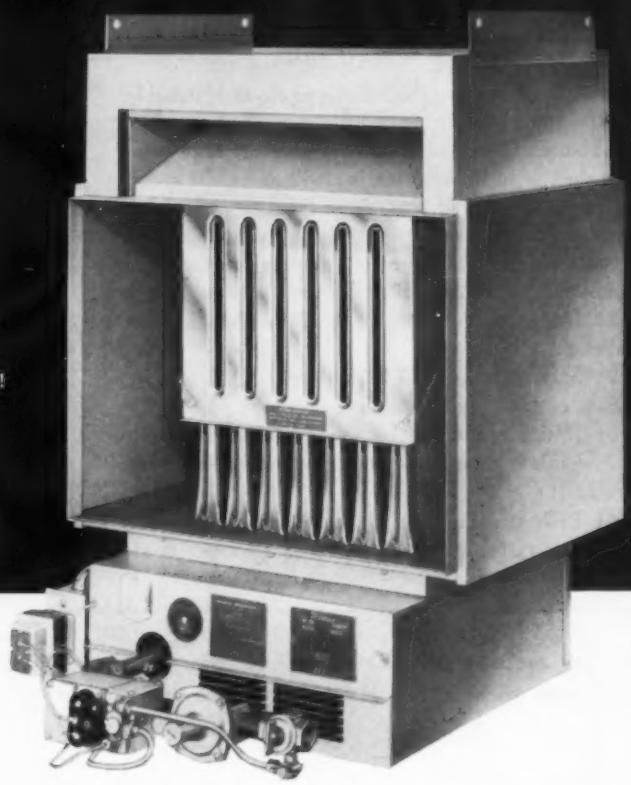

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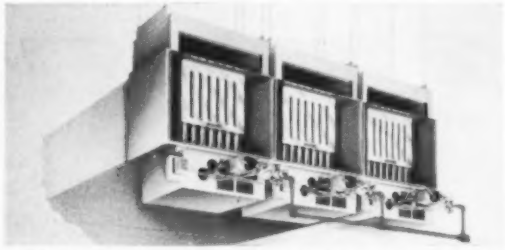

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question of the month

continued

to determine whether the adhesive cement is suitable for the application.

Although H. H. does not state what the high pressure duct is to be used for, we will assume it is for air conditioning and pass along these bits of advice based on experience garnered during many sleepless nights trying to make some of these high pressure air conditioning dreams work:

1) Design on the basis of an all-air, dual-duct installation.

2) Stay within 4 to 6 in. WG system pressure by the use of static regain design in ductwork.

3) Design around one of the several constant volume, constant pressure, air mixing, sound attenuating boxes.

4) Preheat with return air instead of preheat coils.

5) Design for 100 percent outside air usage to allow cooling with outside air up to 55 to 60 F outside air temperature before mechanical refrigeration is required.

6) If the type of operation, and the budget, can stand a supervisory control panel installation, by all means use it.

7) Provide a manual override in the control circuit to allow manual control of the modulating steam valves to the main coils.

8) *Do not* install automatic control or bypass valves in the chilled water lines at the cooling coil!

9) Use the automatic, dry media, roll-up type of filters.

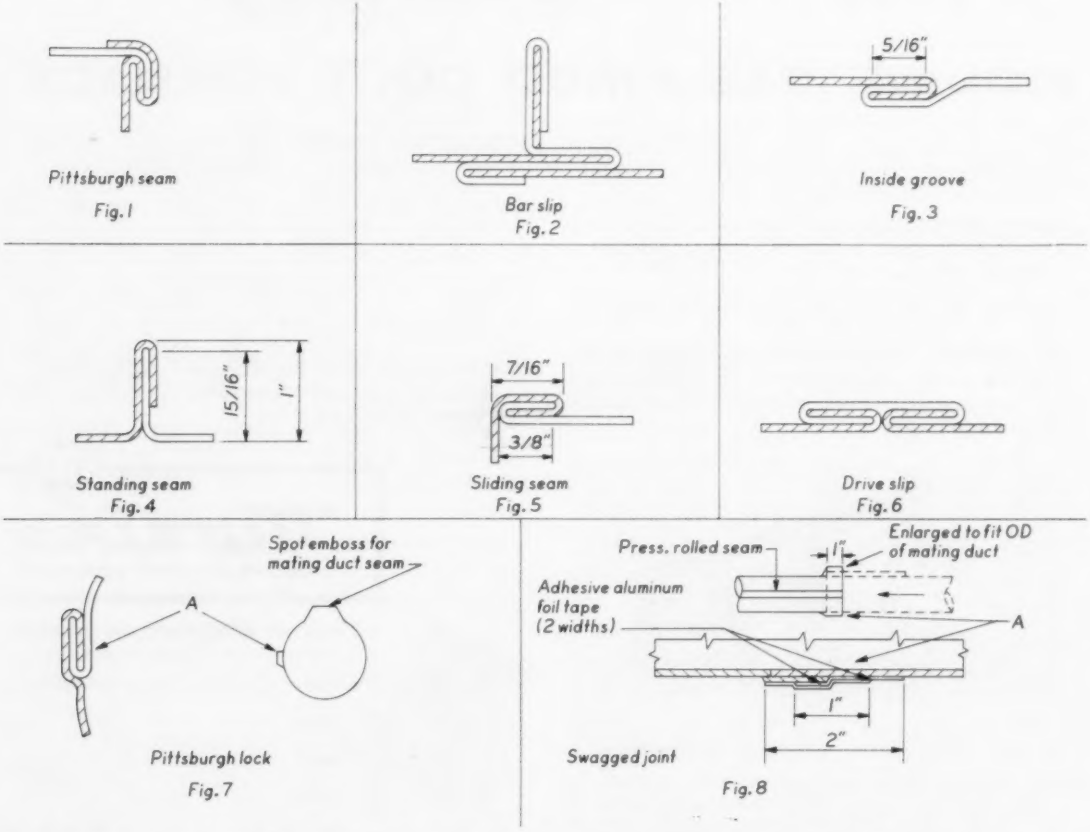
10) Keep the controls simple, either pneumatic or pneumatic-electronic.

11) Provide the most positive return air system you can afford.

12) Eliminate the noise problems at the source — *not* at the point of complaint.

We have not specified brazing for the joints be-

Several methods of joining galvanized steel ducts other than by brazing or welding have been used with success. See H. B. Wayne's answer to this month's Question on page 92.



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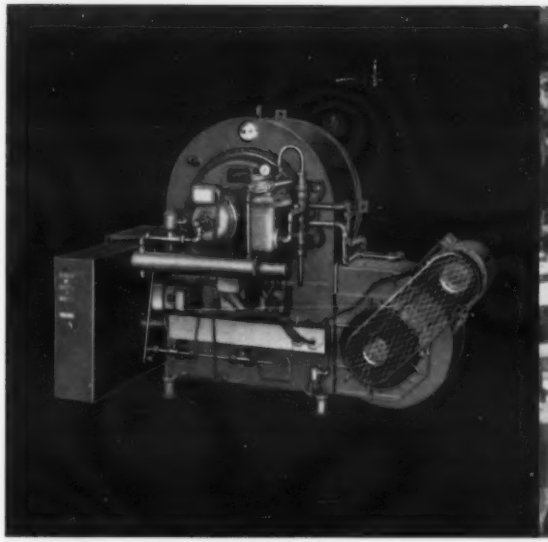

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For the 1960 Winter Olympics site, burner reliability was a paramount consideration. From the start of the project, reliable Ray Burners were specified and purchased. The installed burners are complete—including controls and refractory—and, being forced draft, they eliminate unsightly stacks. The proven efficiency of Ray Burners allows use of low cost residual oils for operating economy at over 85 per cent efficiency. The Squaw Valley installation utilizes the Ray diesel ignition system—although gas-electric ignition is also available. All Ray Burners are factory piped, wired and tested prior to shipment. For complete information on Ray Forced Draft Burners, write for Catalog Unit Y.

RAY BURNER COMPANY
1301 San Jose Avenue, San Francisco, California
629 Grove, Jersey City, New Jersey

cause we have found the installation techniques outlined to be very satisfactory.

E. M. SCHMIDT
Professional Engineer

High Cost of Heavier Gage Sheet Makes Brazing Difficult to Justify

GALVANIZED steel sheet has an approximate chemical composition of 0.10 percent carbon, 0.40 percent manganese, and smaller quantities of phosphorous, sulfur and silicon with a heavy coating of zinc. For 20 gage steel (approximately 0.04 in. thickness), recommended width dimensions of rectangular ducts range between 60 and 120 in. With circular ducts of the same gage, diameters of 40 to 50 in. are acceptable. Since duct sizes have not been stated by H. H., it is suggested these values be reviewed.

Brazed and welded joints require use of heavy gage materials to avoid distortion resulting from the application of heat. This method of fabrication adds unnecessary cost to the installation. Unless heavy wall construction is needed to satisfy pressure requirements, there is no justification for employing this means of duct assembly, even though smooth flow area and pleasing external appearance are available with this design.

Several methods of joining galvanized steel ducts other than by the above mentioned means have been used with success at the pressure levels stated by H. H. Among these are the *Pittsburgh lock, groove* and *inside standing;* all having a mechanical joint for rectangular ducts. The *Pittsburgh* and *swagged* joints (the latter using tapes as sealants) have also proved successful with circular ducts. Details are shown in Figs. 1 through 8 on page 90. Figs. 1 through 6 are typical for rectangular ducts, whereas Figs. 7 and 8 are illustrative for circular ducts. Variations of these assemblies have been installed and have provided satisfactory service.

H. B. WAYNE
Consulting Engineer

READER ASKS—

"Would Stainless Steel Coils Solve Oil Piping Problem?"

"In the last few years, a number of heating projects using much underground piping have been installed with high pressure, high temperature hot water as the heating medium.

"A local supplier markets a heat transfer oil which is suitable for temperatures up to 600 F in a closed circuit and at atmospheric pressure. This fluid seems to offer many advantages. The main disadvantage appears to be its viscosity at temperatures below 10 F and its adverse effects on copper. Stainless steel coils could be substituted.

"Has any considered thought been given to such substitution? If so, what possible pitfalls may we expect? Are there any typical installations? This method seems to eliminate the expansion and corrosion troubles associated with water.

"Information from readers will be appreciated."—R.C.M.

• *YOU ARE INVITED to contribute a question for publication, or an answer to a published question. Please address your reply to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

AN INVESTMENT IN COMFORT

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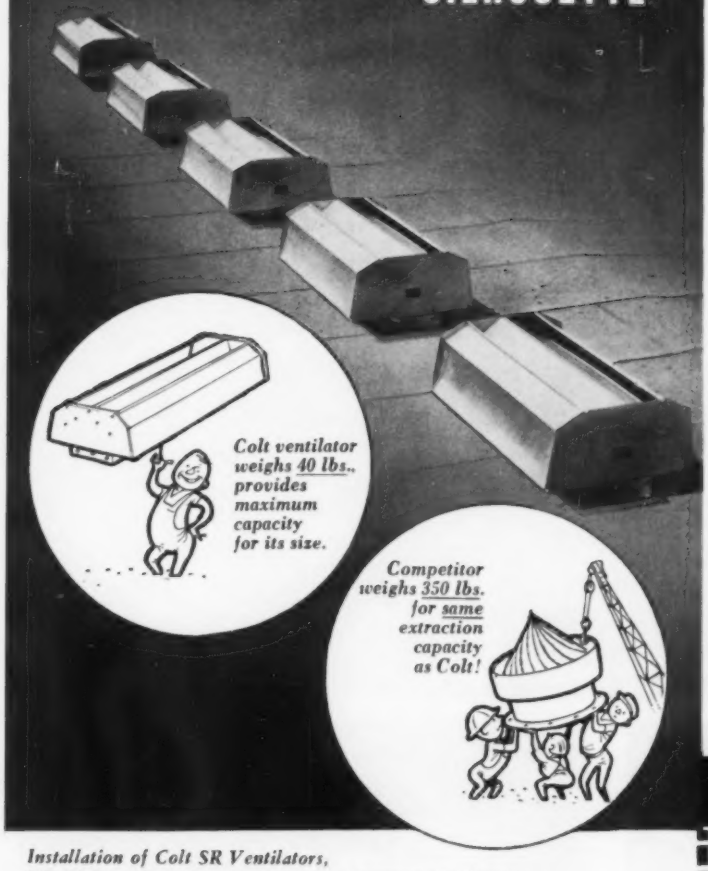
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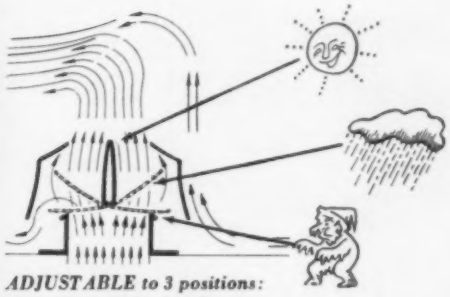

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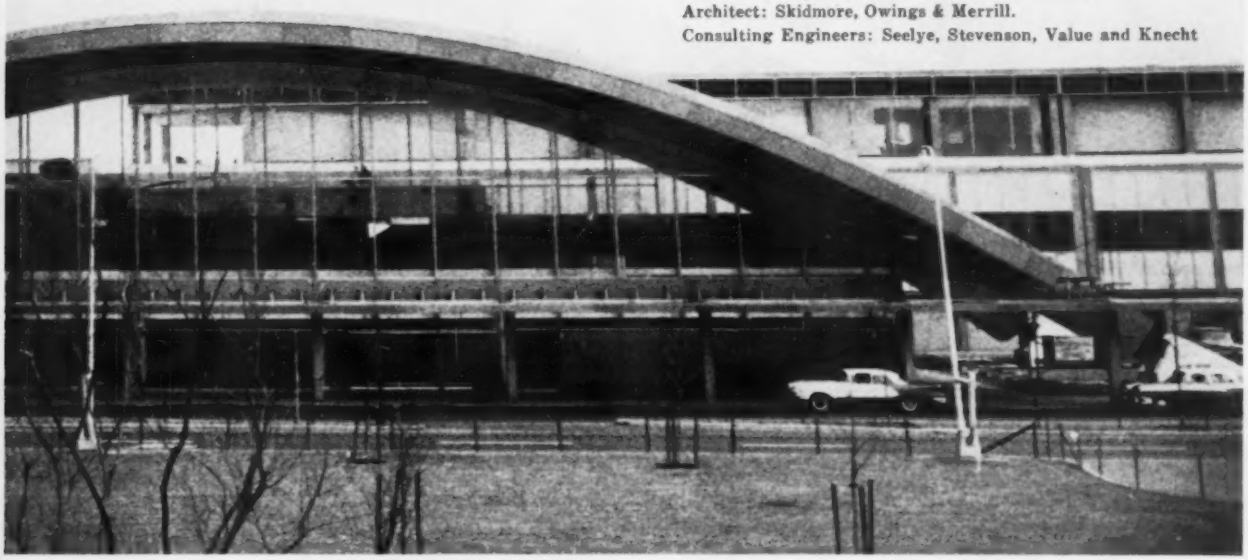

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Gas-operated Carrier machines feature start-stop push button control... adjust from full to zero load and back again *automatically*. With virtually no moving parts, they provide dependable low-cost operation.

New York International Airport gets chilled water for air conditioning its huge complex of Terminal City buildings from Carrier Absorption Refrigeration – one of the most efficient, up-to-date, economical types of systems available today.

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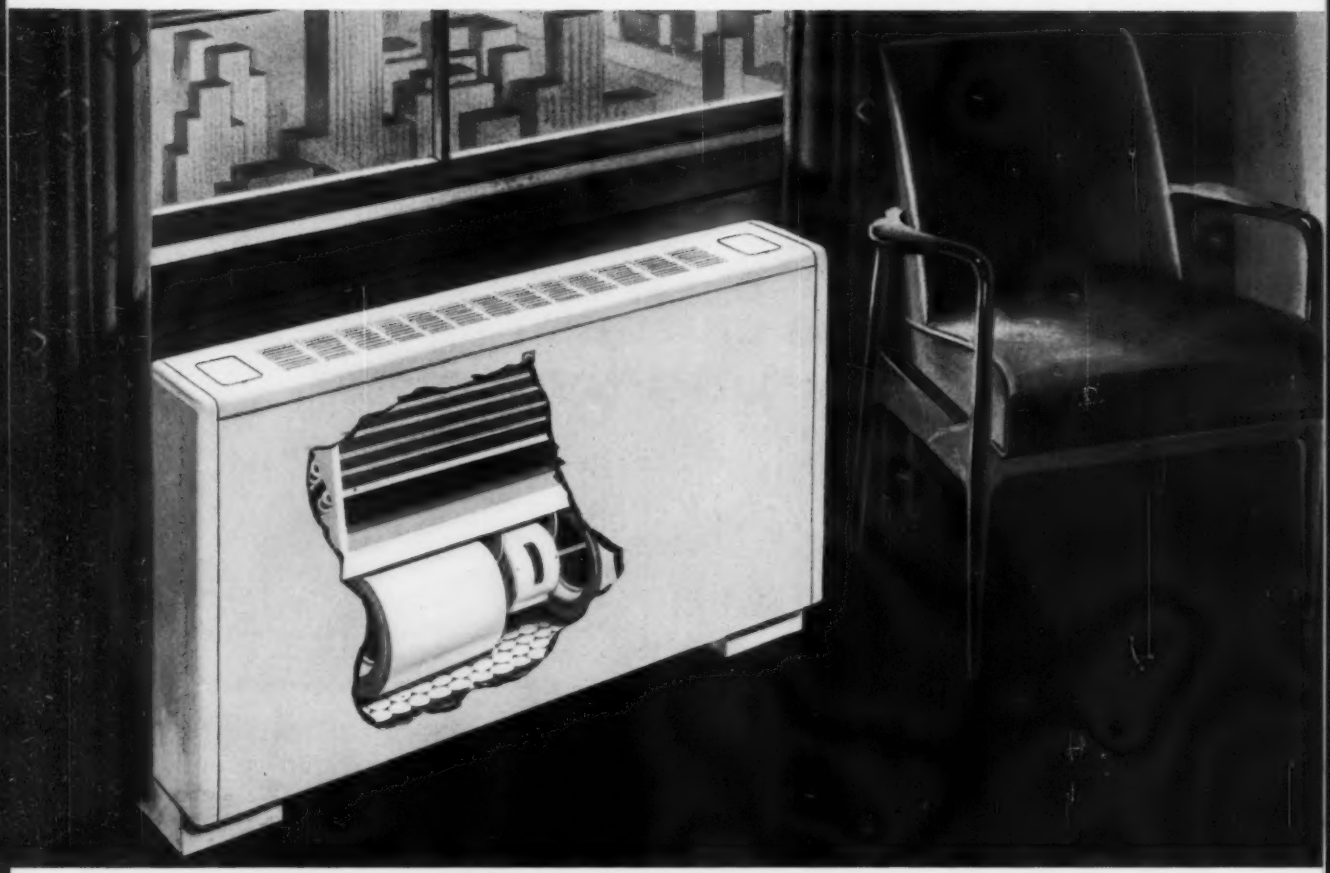
This same type of automatic operation can make your boilers pay off all summer, too – with low-cost comfort cooling. For full details, call your local gas company, or write Carrier Corporation, Syracuse 1, New York. *American Gas Association.*



THE UNITS: All Type 20 fan-coil units are a space-saving 9″ thin and 25″ low with individual-room-unit control for complete operating flexibility. They're available in three convenient models and four practical sizes, either recessed or free-standing. Remotaire units are exceptionally quiet because of slow-speed motors (1,050 rpm max.), large coil surface and filter area, heavy insulation, no reactors or autotransformers.

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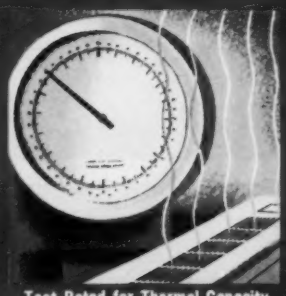

Test-Rated for Thermal Capacity

Test-Rated for Quietness

Test-Rated for Humidity Control

electrical characteristics

unit size	motor input watts	nameplate amps	locked rotor amps	power factor
	shaded pole motors			
200	64	0.8	1.1	.69
300	107	1.4	1.9	.67
400	108	1.4	1.9	.67
600	168	2.5	3.5	.59
	permanent split capacitor motors			
200	36	.32	.41	.98
300	70	.68	.98	.90
400	72	.70	1.15	.91
600	110	1.10	1.80	.87

note: based on 115/1/60 power supply, motor at high speed, basic controls.
With solenoid valves, add 0.2 nameplate amperes and 11 watts.

IMPORTANT!

DON'T OVERLOOK ELECTRICAL CHARACTERISTICS WHEN YOU SPECIFY FAN-COIL UNITS

You'll save both wiring and operating costs

Significant savings result when you choose fan-coil units with permanent split capacitor (psc) motors. By using American-Standard Type 20 Remotaire year 'round air conditioning units, you can choose either psc motors (optional) or shaded-pole motors (standard). Specify the optional psc motors, and you can expect the following savings:

Initial cost is low, because low current input of permanent split capacitor motors allows more units to be installed on each fused circuit—saving on wiring, switch gear and panel boards. By specifying psc motors in any of the four individual sizes of Type 20 Remotaire units, only half the number of current-carrying circuits are needed, as when shaded pole motors are used.

Operating cost is low, because of the careful matching of motor to fan load, high power factor and low power consumption (watts).

Here's a specific example in an office building with 400 units each of 400 cfm capacity. At 1,050 rpm and 115v, single phase, 60 cycles, the power input for the size 400 Type 20 is 108 watts with the standard shaded pole motor; 72 watts with the optional psc motor. Therefore, with the psc motor, the power saving is 36 watts per unit or 14.4 KW for the 400 units. A saving of 14.4 KW amounts to 144 KWHRS energy saved per 10-hour day. In a 250-day business year, total energy saved is 36,000 KWHRS. The saving, at $.02 per KWHR, is $720 a year. The extra cost for psc motors would be recovered in about 4 years. Thereafter you save $720 a year.

All American-Standard 60-cycle motors used in Type 20 units include six-pole electrical construction, three built-in speeds with four simple color-coded leads.

Type 20 Remotaire units are part of a hydronic* system in which the same small-diameter, flexible pipes carry hot water for heating and chilled water for cooling from a central boiler-chiller team to these under-the-window fan-coil units.

For a full description, see your American-Standard representative or write AMERICAN-STANDARD, PLUMBING AND HEATING DIVISION, 40 W. 40 St., New York 18, N. Y.

**Hydronics—the science of heating and cooling with water*

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PLUMBING AND HEATING DIVISION

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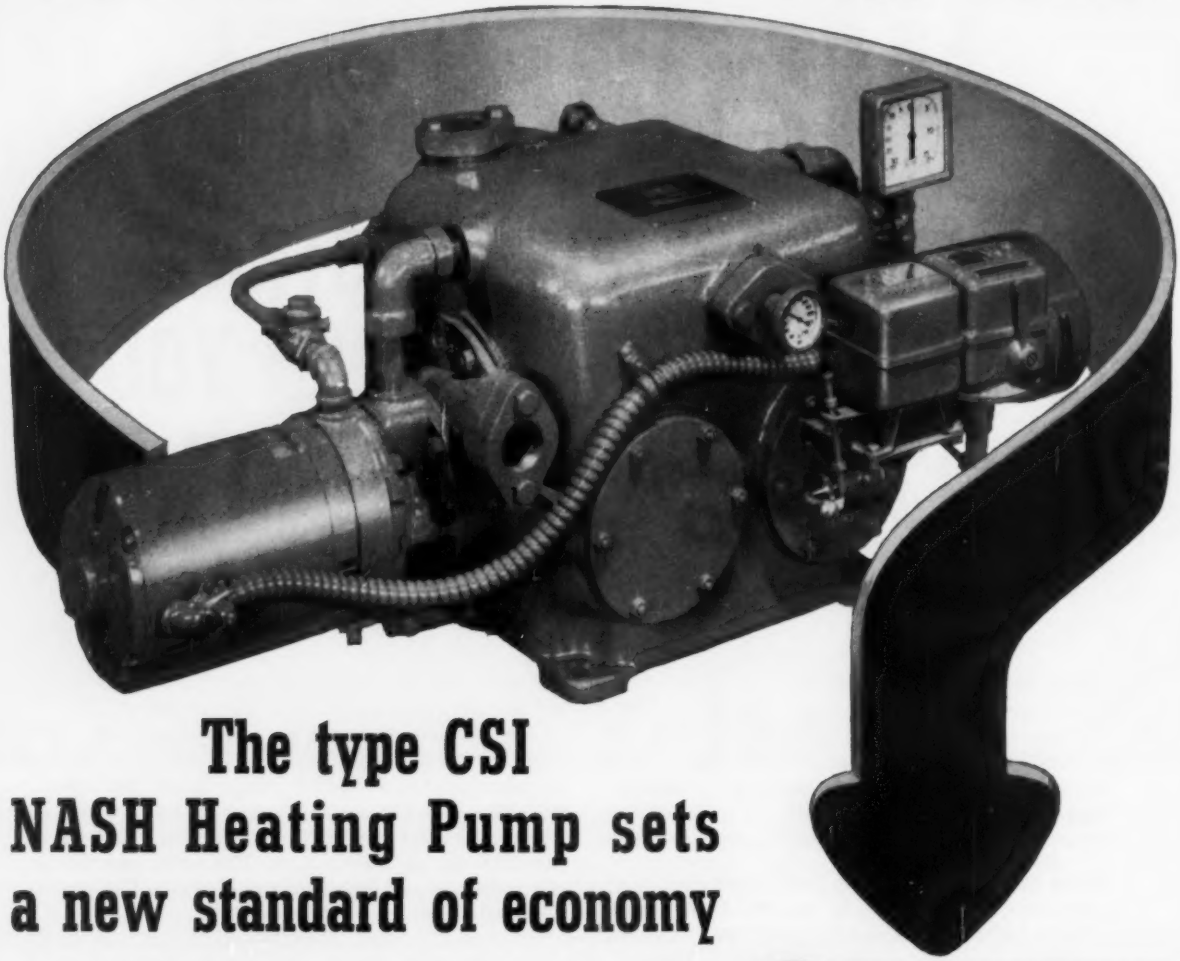

The type CSI NASH Heating Pump sets a new standard of economy

Now a Nash quality Vacuum Heating Pump can be economically installed and operated on any steam heating job. Engineered for high performance and low installed first cost, this new pump still makes use of time tested Nash principles of operation.

The Nash CSI has generous air capacity and features a wide choice of water capacities and discharge pressures. The right combination of capacities is at hand to match the requirements of the job. It is no longer necessary to pay extra for a pump with excessive water capacity, excessive discharge pressure, or in an attempt to get adequate air capacity.

With this advanced design, Architects, Engineers and Contractors will find answers to many heating system problems. Send for bulletin now.

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Olympic Heat Pump Installation Warms Spectators, Melts Snow

Novel system at Squaw Valley delivers heat removed by ice rink refrigeration system

BY DAN VANDAMENT
Vandament & Darmsted
Consulting Engineers

EARLY IN the planning stage it was erroneously believed that the Olympic Winter Games facilities at Squaw Valley, Calif., could be erected at a nominal cost. We knew even then that there would be plenty of snow, but the temperatures are often mild and some refrigeration would be required to maintain skating facilities. In May 1956 we began to work on

SQUAW VALLEY, nestled in California's Sierra Nevada Mountains, is scene of VIII Olympic Winter Games. Later this month, skaters and skiers from many nations will vie for gold medals at these facilities, built at a cost of about $12 million. Large structure, center, is ice arena with seating for 10,000 spectators. At left and right of arena are outdoor hockey rinks. Directly in front can be seen speed skating oval. All rinks are served by central refrigeration plant

this project. Much time was consumed in establishing the scope of facilities needed, weather records, data on available power and fuel, and establishing the basic loads, sizes, etc. This project grew from an estimate of $5 million to a present $12 million.

The ice skating facilities required were one ceremonial and exhibition rink 85 × 190 ft to be located in the main arena (this rink was to be covered by a roof and surrounded by bleacher seating to accommodate 10,000 people); one outdoor speed skating rink 600 meters long, oval in shape, and with a practice surface adjacent; and two rinks 85 ft × 190 ft to be used for outdoor hockey games and practice areas. This all adds up to 120,000 sq ft of rink surface—the largest of its type in the world.

From the start we realized it would be best and most economical if these rinks were grouped together and were served from one central refrigeration plant. So the basic layout of the entire facilities was modified to bring these rinks into close proximity and retain the desired flexibility. Once this was achieved, we started to estimate our total load.

Climate Plays Big Role

Climate played a big part in our considerations throughout. The snowfall in this part of the Sierra Nevada Mountains equals that encountered anywhere in the world. Squaw Valley, located a short distance northeast of Lake Tahoe, is only about 50 miles north of Tamarack, Calif., holder of the world's record for snowfall.

In Squaw Valley the snow pack may vary from a maximum of 26 ft to a minimum of 20 in. An average of about 8 ft is anticipated during the February-March period of the games. Mean daily average temperature to be expected at this time of year is 32 F. Mean daily maximum is 42 F. Temperatures as high as 72 F in March and 65 F in February have been recorded. Rain, too, may occur during this period.

Since we were faced with less than unlimited funds, we were required to take calculated risks. We would not try to hold all surfaces in every kind of weather. If rains occurred we would sacrifice the outdoor rinks entirely. If climate conditions exceed 5 mph wind with 60 F air temperature at 85 percent relative humidity, one or more rinks will be shut off in order to hold the remaining surfaces in good condition.

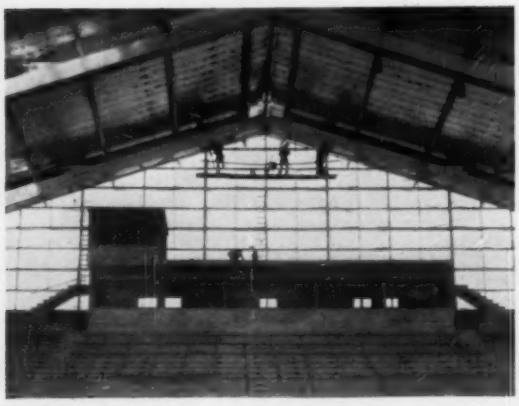
Direct sun affects these conditions also. However, with a cold brine storage tank located in the ground under the mechanical equipment room we are able to obtain some diversity. Another fact to consider is that mountains create shadows for about 21 out of 24 hrs. Our total calculated tonnage is 550 producing 14 F brine at 110 F condensing temperature. This can be increased by use of water on the condensers to about 600 tons at 90 F condensing temperature.

Compressor Selection Saves $80,000

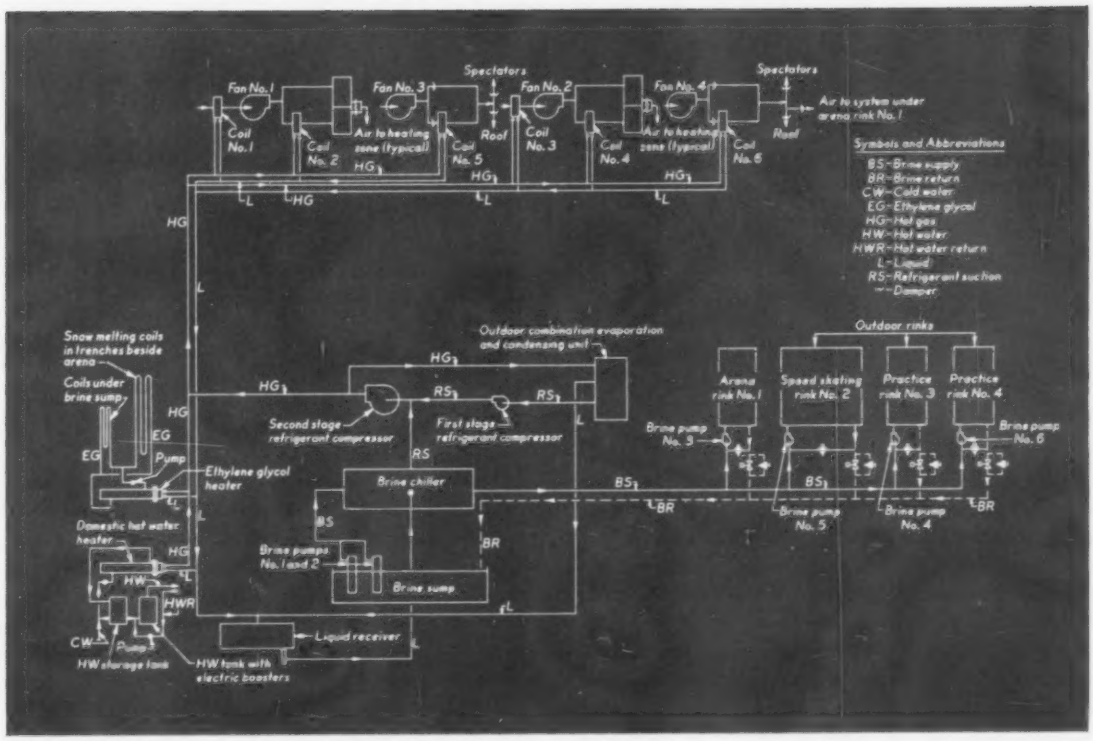
Once we established our loads, we began to study the equipment to be used. Very early we decided to use a centrifugal compressor for flexibility, reliability, small physical size, and economy. Because of budget problems we decided to use one single compressor in lieu of two or three. Bids later proved that this saved about $80,000.

Next, we started to study the types of condensers suitable for the climate. At this point it struck us that we had a tremendous amount of heat to waste and that simultaneously we were going to be providing a lot of heat expensively from oil fired boilers for the arena to provide hot water, to reduce condensation, etc. We began to study the feasibility of using our compressor as a heat pump. The further we delved into it, the more attractive it became.

We discussed power consumption with the electric power company and found them quite interested. They had a capital investment problem to supply



PARTIALLY COMPLETED grandstand of main arena pictured at left. Workmen are installing large ducts which will supply heated air to bleacher seats and to snow melting outlets in roof



FLOW DIAGRAM for combination refrigeration and reverse cycle heating system is shown above

adequate dependable power into the Squaw Valley area. A new 66,000 volt line was to be built connecting the Tahoe feeder to the two Truckee feeders, then to run a new 14,000 volt line into the valley. It had been felt that the Winter Games organization would have to stand most of this cost, or about $250,000 outlay.

We were told by the power company that if this refrigeration unit could act as a heat pump with a reasonable use factor, they would consider installing these lines free to the Olympic Committee. This was a real windfall. The project was in serious budget trouble by now, and calculations and estimates showed we could install this unit as a heat pump for about $90,000 less than as a refrigeration unit combined with a boiler plant. Besides, there were serious architectural objections to a boiler plant with its stack, oil tanks, combustion air requirements, and space needs.

Heating Costs Extremely Low

We then checked costs of operation and found that our unit had a coefficient of performance of from 2.6 to 3.5 when operating only as a heat pump. Also, many hours of actual refrigeration load are anticipated and this provides, in effect, totally free heat. A complete and accurate analysis approaches the impossible, but estimates indicate our power costs to produce heat will be about 60 percent of the cost with the cheapest heavy oil.

This unit will produce about 5.5 million Btu at −5 F outdoor temperature and 6.6 million Btu at 10 F. From here on up, a refrigeration load is expected and, at 40 F, the total heat available is 9 million Btu.

Melt Excessive Roof Snow

We next worked closely with the structural engineers to see if we could do something about the excessive snow loads encountered in this climate. We developed a roof system using steel cells and a warm air duct feeder. By this we plan to blow hot air into each cell of the roof and melt the snow.

Complete melting is not considered practical. It is planned to allow the snow to build up on the roof for a depth of about 18 in. This then becomes a fairly effective insulating blanket. When hot air is introduced into the roof, the lower ¼ in. or so of snow is melted and the whole mass then slides off. To do this the mass must reach a reasonable depth in order to hold together and move as one piece, or rather in several large pieces. This operation is manually selective.

Snow may be removed from either or both sides.

SPEED SKATING OVAL, 400 meters around, is embedded with 1¼ in. thin wall steel brine tubing which runs longitudinally with path of skaters to avoid "wash boards"

If cold wind conditions prevail it is planned to clear only one side at a time. The structural engineers were able to reduce their costs by about $300,000 in this one item alone. By using this same system we can warm up the entire structural roof system and reduce condensation on the members.

We use this same air distribution system to provide warm air to the spectators' bleacher area. This arena is enclosed on three sides with one end open. We will draw in 100 percent outdoor air and provide a flow of warm or tempered air out the open end. Heating for the spectators will therefore be imperfect, but will still add greatly to their comfort.

The building may be unoccupied during some winter periods, but still the plumbing facilities must be kept from freezing. So we have designed the system to permit complete recirculation of air in the lobby, office, and toilet room areas. Three-speed fans are used for both supply and exhaust and a total of 27 combinations of operating conditions are possible, depending on the requirements.

Other uses of heat from our reverse cycle unit are: domestic hot water heated to 100 F and then boosted by direct electric heat; office heat; lobby and concession area heat; locker room and toilet room heat; snow grate heat at entrances; ethylene glycol systems serving to melt the snow fallen from the roof and defrost around the brine sump; heat for press, radio, TV facilities, and VIP seating; and warm air heat under the arena rink floor to defrost the area and/or melt the ice preparatory to use for other events.

In developing this reverse cycle system, refrigerant No. 12 is used. It has desirable characteristics for the low temperatures of brine used and in air-to-air evaporators for straight heat pump operation. A 200 hp centrifugal booster compressor is used to bring suction temperatures down to as low as −30 F.

The main compressor is a multi-stage centrifugal unit providing four stages of compression. The unit is capable of operation to upwards of 125 F, but is designed for 110 F hot gas for heating. This hot gas is piped to special heating coils and returned as a condensed liquid. The air-to-air heat exchange coils serve a dual purpose, acting as either a heat pump medium or condenser, depending on operating conditions.

A large concrete brine storage sump is constructed below the floor of the refrigeration room. It is planned to pull this down to 5 F or even zero F at night to provide extra available tonnage for warm sunny daytime use.

Each rink has its own vertical turbine type brine circulating pump and a control valve so that it can operate on 16 F brine when zero F brine is available. Provision is made to vary ice and surface conditions on each rink independent of other rinks. A 48-point indicating potentiometer checks ice conditions, brine temperatures, etc., throughout the system. A color-graphic control panel shows conditions throughout the operations.

Over 100 Miles of Rink Piping

The arena rink consists of a concrete slab with 1¼ in. Schedule 40 steel pipe spaced 3½ in. on center. The speed skating rink uses 1¼ in. thin wall steel tubing 4 in. on center, embedded in sand. Pipes are run longitudinally with the rink, even around the curves to reduce or eliminate "wash board" effects. Pipes in this surface alternate in the direction of flow to provide the most uniform conditions. The other two outdoor rinks use 1¼ in. thin wall steel tubing on 4 in. centers with return bends and end headers. These pipes are also buried in sand. Over 100 miles of pipe are used in the entire system.

It has been conservatively estimated that over $1 million in construction costs were saved by the various features that were used in lieu of a more conventional design approach.

The mechanical (heating, piping, and air conditioning) contractor for this installation was Whelan Plumbing & Heating, Inc. ⋕

LESTER T. AVERY, author of this feature, is president of Avery Engineering Co., Cleveland mechanical contractor, and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors. On this page, he reflects on his installation experiences.

Too Many Fins Can Bottle-Neck Heat Transfer

ONE OF THE first air cooled condensers was called a "bird cage." This was comprised of a plain copper tube coil which was wound around the base of an early model condensing unit. For condensing, it depended chiefly on convection currents, plus a little air moved by the fly wheel fan.

The balance was good. These machines stood up amazingly well until they were replaced by the more modern fintube with fan condensers.

The size of the air cooled condenser has always been limited, since the areas of surface operated dry are excessive. Therefore its development has been handicapped by relatively high cost, as compared with other methods of condensing. Air cooled condensers have proved attractive in refrigeration applications where the machines must run during the wintertime.

Some installations combine the features of an evaporative condenser with those of the air cooled type. Here, the water is drained out at freezing temperatures and the condenser coil acts as a forced air condenser since the surface is adequate under these low temperature conditions.

Several operating and maintenance problems occur with air cooled condensers that are peculiar to them. The maintenance problem seems to be especially critical because accumulation of dirt on and between the fins can stop the flow of air.

It seems as though the use of fins has become so widely accepted that the manufacturers are making them closer and closer together — even to the extent of 14 or more fins per inch. Professor Tuve, who has done a great deal of research on testing heat transfer surfaces, points out that all of the heat to be removed from the product, whether it be air or liquid, must pass through the *prime* surface of the tube. Increasing the frequency of fins, he says, may not increase the overall heat transfer, which is bottle-necked at the primary surface.

Our observation has been that close fin spacing furthers the collection of dirt. On small window units the rain which comes in with the air makes mud of this dust and dirt. Gradually, the heat of condensation bakes this until you have a very poor condenser.

We have mentioned in other articles on condensers how high pressures due to dirty condensers can cause compressor troubles. This is certainly the case on the window unit where everything is in very close balance. But where the condenser may have very little air going through it and very poor heat transfer due to accumulation of mud, the problem becomes much more serious.

On air cooled condensers that operate in cold weather, the problem of maintaining proper high discharge pressure must be solved. This can be done by controlling the flow of air or by holding back the liquid in the condenser, thus reducing the condenser capacity. Both of these must be operated from a pressure control of some kind.

Now, with the use of air cooled condensers becoming evaporators in the heat pump system and the larger sizes being made available, the question of fins really becomes a problem. Close fin spacing aggravates the collection of snow and the difficulty in defrosting. Possibly we will return to the bare prime surface or at least something in the neighborhood of four fins per inch and work out a better counter-current flow of air and gases whereby the air cooled condenser will function properly in hot weather and at the same time can be used as an evaporator for the heat pump system.

High surface areas with too many fins cause more trouble than they cure. Plenty of prime surface and limited fins will prove easier to maintain and will operate better under more adverse conditions. Once again, it's the operating point of view as opposed to low first cost.

Yes, the condenser, whether it be water cooled, evaporative or air cooled, is a very much neglected but important component of the refrigeration plant. ≠

How to Design Suction Piping, Deaerator Storage Capacity

. . . to protect boiler feed pumps

• This article presents an analytical method for determining the minimum permissible weight of water ratio between the deaerator storage tank and the suction piping to the boiler feed pump. With sufficient capacity, this tank is capable of insuring against flashing at the pump's suction, thereby avoiding cavitation and vapor binding of the pump.

Mr. Thurston holds an MS in mechanical engineering from Columbia University. He has been employed by the American Electric Power Co., served as a teaching assistant in thermal engineering at Cornell University, and is currently with the Nuclear Propulsion Div. of the Los Alamos (N.M.) Scientific Laboratory of the University of California.

BY RODNEY S. THURSTON
Formerly, Dept. of Thermal Engineering
Cornell University

ENGINEERS involved with the design, installation, and operation of power piping systems usually realize that, to avoid flashing, the pipeline between a boiler feed pump and a deaerator should be as direct as possible. Also, the piping should take advantage of the largest static head reasonably available in the plant. The safe and economical sizing of the suction line and deaerator storage capacity can be achieved by analytically examining the roles of such equipment when the boiler feed pump is in greatest danger from flashing, i.e., during a sudden decrease in load.

The most prominent function of a deaerator storage tank is the absorption of feedwater surges during load variations to insure a continuous liquid supply to a boiler feed pump. In storing water, this vessel also stores a considerable amount of heat in the form of saturated liquid which can be released as the deaerator pressure decreases. The released heat slows the enthalpy decay rate. As enthalpy is directly related to pressure at saturation, the rate of pressure decay is likewise lessened.

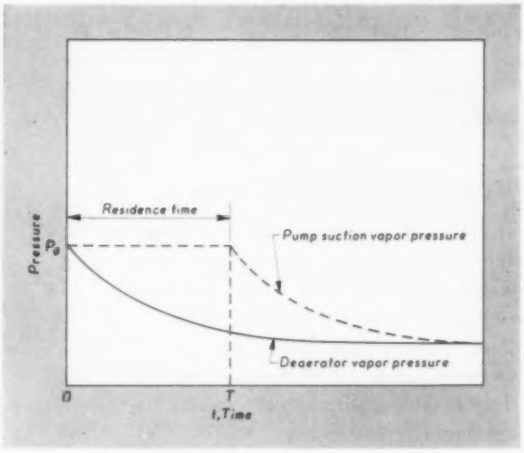
This article is based on a paper presented at the recent ASME annual meeting in Atlantic City.

To avoid flashing, with its consequent cavitation and vapor binding of the pump, the static pressure at the eye of the impeller must never decrease below the vapor pressure of the feedwater at that point. However, as it is not practical to measure pressure at the eye of the first stage impeller, it is the practice to transplant this measurement to the pump entrance. A net positive suction head (NPSH) above the vapor pressure (supplied by the manufacturer) allows for the decrease in static pressure between the pump entrance and the eye of the first stage impeller.

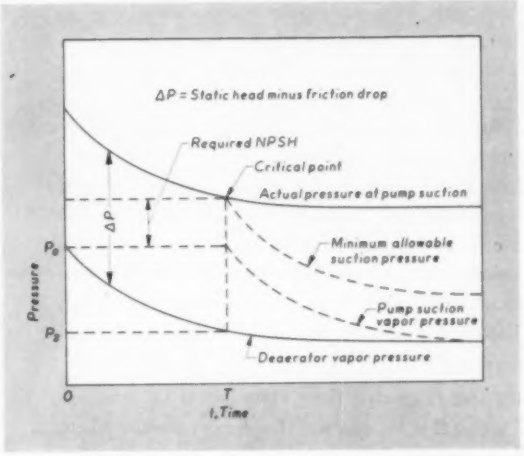
The actual pressure felt at the pump suction is the sum of the deaerator pressure and the static head due to the water level in the storage tank above the pump center line, minus the friction drop in the piping. The minimum allowable pressure at the pump suction is the vapor pressure (which is a function of temperature only) plus the required NPSH.

With an initial decrease in load, the deaerator pressure drop causes some of the water in the storage tank to flash into steam. This continues until saturation is attained at the new pressure. The water in the suction line has a static head exerted on it by the level in the storage tank which keeps it from flashing immediately. Therefore it is considered as a trapped slug of hot fluid which has to be moved through the

1 TRANSIENT VAPOR PRESSURES with sudden flow drop react as is shown at right



2 TRANSIENT PRESSURES for critically sized deaerator storage tank charted here



boiler feed pump. (Natural circulation between the hot and cold masses in the suction line is neglected.)

The situation of a decreasing deaerator pressure and a constant vapor pressure will continue to exist until all of the water originally in the suction line when the load drop started passes into the pump. Then, and only then, is the pump entrance considered to perceive a drop in feedwater temperature, hence a decrease in vapor pressure. As the minimum allowable pressure remains constant while the actual pressure decreases, a situation is foreseeable wherein the actual pressure may drop below the required minimum, resulting in transient cavitation in the boiler feed pump.

Thus, the essence of the problem is to control the rate of pressure decay in the deaerator so that the pressure at the pump suction is not diminished below the minimum permissible. As saturated pressure is a direct function of saturated enthalpy, the principal control mechanism is the body of hot water stored under the deaerator.

Residence Time Delays Vapor Pressure Decay

A limitation to an allowable pressure decay rate is presented by the suction line. It not only establishes the available NPSH at the pump suction, but also contains a volume of fluid which must pass through the pump before the suction vapor pressure will start to decay. The time absorbed in passing this high temperature water is referred to as the residence time of the suction line and is defined by:

$$T = V/Q = m/W \quad \text{.....[1]}$$

where:

T = residence time, sec
V = volume of fluid stored in suction line, cu ft

Q = flow rate through feed pump suction line, cfs
m = weight of fluid stored in suction line, lb
M = deaerator storage capacity, lb.

This concept is illustrated in Fig. 1. At $t = 0$, the deaerator pressure starts to decay. However, not until $t = T$, is the vapor pressure at the pump suction likewise considered to decay.

Simplify Deaerator Pressure Decay

To arrive at an uncumbersome expression for the deaerator pressure decay, a number of simplifying assumptions have to be made. The equations evolved here are contingent upon the following:

1) That complete mixing occurs between all fluids entering the deaerator, such that the enthalpy of the water leaving the deaerator corresponds to that of saturated liquid

2) That, during the residence time, the feedwater and condensate flows are equal and constant

3) That the condensate enthalpy is constant at its magnitude corresponding to the end of the residence time

4) That the effect of the steam mass and the deaerator's metal mass is neglected.

Although the magnitudes of the condensate and feedwater flows are assumed constant, they always fluctuate in any actual installation. However, for the time being, the constant flows can be thought of as the average effective flows. It will later be shown that these flows actually cancel in the desired capacity equation.

From the residence time equation it at first appears necessary to specify the flows mentioned to determine the condensate enthalpy of assumption (3). However, if, as in most designs, the volume of piping from the downstream heater to the deaerator is greater than that from the deaerator to the feed pump, the condensate enthalpy will be that leaving the heater. If the inlet piping to the deaerator is insufficient, or if the designer wants to guard against the event of the heater being out of service, the exit enthalpy of the next downstream heater may be used.

Using these assumptions and considering the deaerator's change in enthalpy during an interval dt:

$$M \times dh = h_c W \times dt - hW \times dt \quad \text{.....[2]}$$

where:

h = deaerator enthalpy at end of residence time t, Btu per lb
h_c = condensate enthalpy at end of residence time
W = condensate or feedwater flows, lb per sec.

Rearranging terms:

$$dh/dt = h_c(W/M) - h(W/M) \quad \text{.....[2a]}$$

The solution of Equation 2a is:

$$h = (h_o - h_c)\, e^{-(W/M)\, t} + h_c \quad \text{.....[3]}$$

h_o = initial deaerator enthalpy
e = 2.1718.

The corresponding saturation pressure for the enthalpy obtained by Equation 3 can be obtained from the steam tables. The deaerator pressure curve of Fig. 1 represents Equation 3, expressed in terms of pressure.

How to Design for Storage Capacity

Fig. 2 is an illustration of how the residence time concept and Equation 3 are used in designing for storage capacity. It actually consists of two curves superimposed on Fig. 1. One represents the actual suction pressure at the boiler feed pump (deaerator pressure plus static head minus friction drop); the other, the minimum pressure allowed at the pump suction (suction vapor pressure plus required NPSH). The condition shown is for a critical design in which the storage tank capacity is the minimum permissible.

The juncture of the two curves in Fig. 2 indicates the analytical solution to the problem. By letting $t = T$, the residence time, in Equation 3, the storage capacity is obtained as:

$$M = TW/\log_e[(h_o - h_c)/(h_2 - h_c)] \quad \text{.....[4]}$$

The enthalpy at the end of the residence time, h_2, is that for saturated water. Its corresponding pressure is:

p_2 = p_o + required NPSH − (static head − friction drop) .....[5]

Equation 5 demonstrates that, if the static head less friction drop just equals the required NPSH, p_2 would equal p_o and no pressure decay would be permissible regardless of how immense the storage capacity or how small the suction piping volume.

From Equation 1 the residence time can be replaced by m/W, yielding:

$$M = m/\log_e[(h_o - h_c)/(h_2 - h_c)] \quad \text{.....[6]}$$

As neither the condensate nor the feedwater flow appears in this expression, no decision need be made as to what constant rate should be assumed during a period in which the rates are actually fluctuating.

Compare Alternate Systems

Equation 6, by establishing a minimum safe storage capacity for a deaerator, can be used to compare alternate arrangements of deaerator and suction piping. Such an application is shown in the following table. The computations for the base system are included toward the end of this article.

	Base system	Enlarged suction line	Increased static head
Pipe size, in.	12, 10	18, 12	12, 10
Gross head, ft	90	90	100
Friction drop, ft	13	3	13
Required NPSH, ft	51	51	51
Excess NPSH, ft	26	36	36
Excess NPSH, psi	10.2	14.2	14.2
p_2, psia	77.8	73.8	73.8
Suction water, lb.	5540	8760	5985
Storage water, lb	84,200	91,900	62,800

Example of Minimum Storage Capacity Calculation

(System studied is shown at right.)

Gross static head: 90 ft

Volume of 12 in. pipe: (1) (100) (0.786) = 78.60 cu ft

Volume of 10 in. pipe: (2 × 10 + 1 × 1 × 15) (0.546) = 19.11 cu ft

Total volume of piping to one pump: 97.71 cu ft

Outlet enthalpy from second downstream heater: $h_c = 150.0$

Deaerator conditions at safety valve pressure:

$p_a = 88.0$ psia

$h_a = 288.9$ Btu per lb

$t_a = 0.01764$ cu ft per lb

$v_a = 318.7$ F

From full flow considerations at boiler feed pump:

Required NPSH = 51 ft

Friction drop = 13 ft

From Equation 5:

$$p_2 = 88.0 + (51 - 90 + 13)/(0.01764)(144) = 77.8 \text{ psia}$$

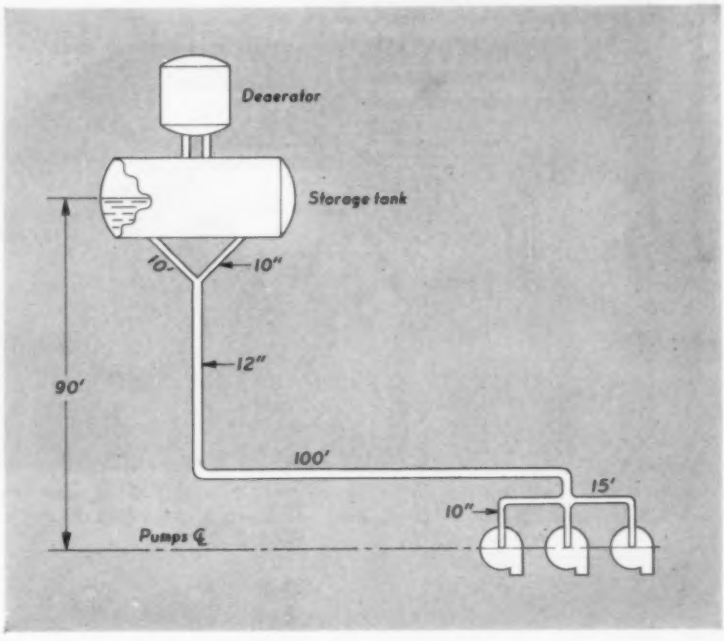
From steam tables: $h_2 = 280.0$

Weight of water in suction piping: 97.71/0.01764 = 5540 lb

Substituting into Equation 6:

$$M = 5549/\log_e [(288.9 - 150.0)/(280.0 - 150.0)]$$

$$M = 5540/0.0658 = 84{,}200 \text{ lb}$$



Of the two methods used to increase the excess NPSH by 10 ft, enlarging the suction line actually intensifies the transient problem, resulting in a larger minimum storage capacity.

By keeping the suction line as reasonably small as possible, the designer can either utilize a smaller storage capacity or, for the same capacity, achieve a greater margin of protection for his feed pumps.

Attaching dollar-values to this comparison would yield the most economical of the three systems.

Summarize Procedure

The following steps are advocated in establishing deaerator storage capacity:

1) Select the expected maximum feedwater flow and determine the required NPSH at that flow.

2) Select the minimum condensate enthalpy expected during the residence time. This will probably be that of the second downstream heater in the event that the first downstream heater is out of service.

3) Determine the value of the deaerator enthalpy h_2 at the end of the residence time from the relation between p_2, p_0, the required NPSH, the static head, and the friction drop.

4) Solve for the minimum ratio between the storage capacity and the capacity of the suction piping. Actual storage must be larger than that indicated here.

5) If it is impractical to use as large a storage capacity as indicated or to reduce the suction piping any further, investigate whether an increase in static head is practical.

Acknowledgments

The author wishes to express his gratitude to Carleton E. Brune, American Electric Power Service Corp., for suggesting the problem and his invaluable discussions, and to Igor J. Karassik, Worthington Corp., for his very constructive criticism of an earlier draft of this paper. ⧺

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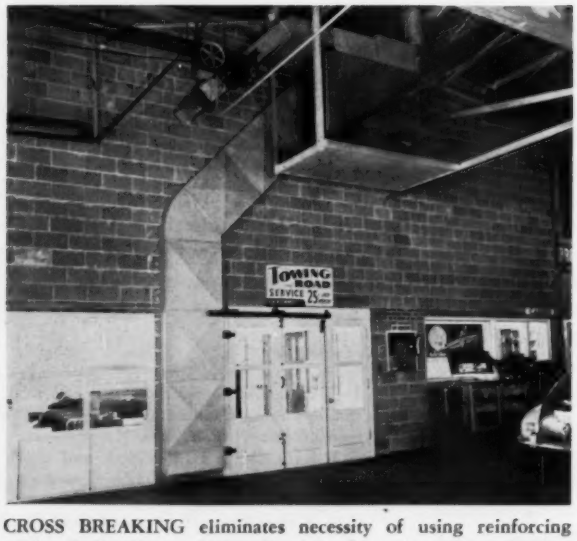
I. J. Karassik, G. H. Bosworth, and W. D. Elston; *Centrifugal Boiler Feed Pumps Under Transient Operating Conditions.* ASME Paper 53 — F-32, October 1953.

I. J. Karassik, G. H. Bosworth, and W. D. Elston (series of three articles in Power magazine); *Effect of Sudden Load Drop in Open Feed Cycles,* October 1955, pp. 96, 97, 218-220; *Designing for Load Drop in Open Feed Systems,* November 1955, pp. 87-89; *How Load Changes Affect Closed Feed Cycles,* January 1956, pp. 88, 89, 202-213.

ONE COMMON METHOD of joining sheet metal ducts is standing seam. Ends of standing seams should be folded over and edges of Pittsburgh locks hammered over this end, as has been done in installation shown above

SMACNA Manual's 'Suggested Specification' Is Engineer's Guide to Good Duct Design



CROSS BREAKING eliminates necessity of using reinforcing angles. Each side, in 19 through 30 in. dimensions, is cross broken from corner to corner to set up tension in sheet to rigidize metal. Steel of 24 gage, aluminum of 0.025 in. thickness are recommended for these duct sizes

BY JAMES H. STIGGLEMAN
Chief Mechanical Engineer
Childs & Smith
Architects and Engineers

IN THIS third[1] and concluding article describing the new *Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems*, published by the Sheet Metal and Air Conditioning Contractors National Association, an attempt will be made to describe how the manual can actually be used in an engineer's plan and specifications.

On pages 121-133 of the man-

[1]Mr. Stiggleman's first two articles, *A Giant Step toward Standardization: SMACNA's Sheet Metal Duct Manual* and *A New Standard for Ductwork Design, Installation: SMACNA's Sheet Metal Duct Manual*, appeared in the November and December 1959 issues, respectively.

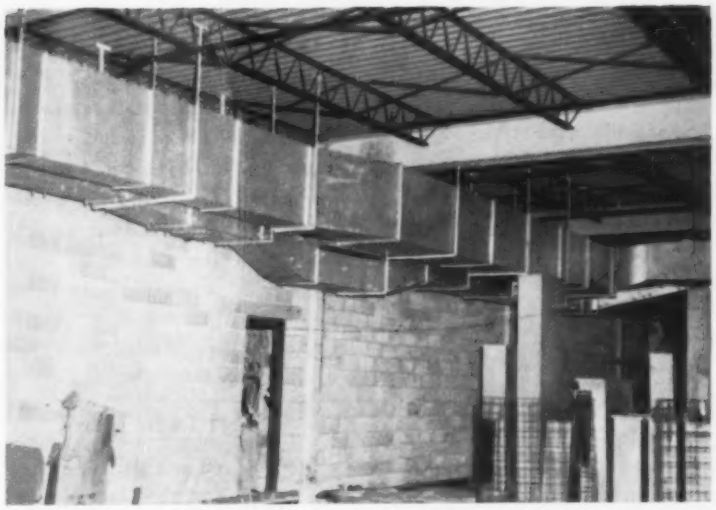
New publication includes section listing most items necessary in preparing good specs for accurate ductwork

ual is a suggested specification for sheet metal work. This specification does not necessarily follow the format used by all engineers. However, it does include just about all the articles necessary in the preparation of a good specification. Actually, it is more of a specification guide. As such, it can be used to advantage.

One criticism I have of the specification is that it does not indicate where there is a choice when referring to the manual. The suggested specification simply says "sheet metal ducts, hangers, dampers, etc., shall be as called for in the *Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems.*"

This, I believe, is far too general where there is a choice of two or more methods. Consequently, it could lead to misunderstanding and argument. Since the purpose of this manual is to eliminate these two sources of frustration and consternation, it would seem advisable to addend this specification somewhat.

Actually, it is possible to use the suggested specification as written and specific plate numbers can be referred to on the drawings. If this is the intent of the manual, it is not explained. It would appear that the best way to use the manual would be to insert in the specifications the exact plate numbers and choices of design for such common items as duct construction, dampers, access panels, belt guards, and similar materials. Unusual items



POCKET LOCK, another popular way to join sheet metal ducts, may be used on 4 ft centers without intermediate bracing. On 8 ft centers, 1 × 1 × ⅛ in. angles should be added on center line in between. This lock, shown in illustration above, is normally used on all four sides

WHERE FANS OR UNITS connect to casings or ducts and are shown on drawings, install fire resistant flexible connections of canvas or other approved material. Such connections prevent transmission of vibration from fans or units to metal ducts or casings

such as hoods, roof exhaust hoods, inspection plates, and test holes, etc., might better be referred to on the drawings.

It really makes very little difference whether the specific choices occur in the plans or specifications. The important thing is that the choice is made and that it is understood by the user of the manual that choices must be made. The fact that the manual does not stress that selections must be made is, in my opinion, its only shortcoming.

Must Pinpoint Construction

Specifically, the type of duct construction desired by the engineer should be pinpointed. For instance, in duct sizes 19 in. through 30 in., there are four selections. The first two are essentially the same. They consist of reinforcing on 4 ft centers.

One describes "S" slips, bar slips or pocket locks on 4 ft centers, while the next shows them on 8 ft centers with $1 \times 1 \times \frac{1}{8}$ in. angles on the center line in between. In reality, there is very little choice between the two insofar as the engineer is concerned; however, if he desires not to allow the use of one of them, he should so state.

These first two methods do not call for cross breaking. The third method describes cross break construction and indicates the use of the "S" slip, bar slip or pocket lock on eight ft centers. The fourth method is standing seam construction. In the case of 19 in. through 30 in. ducts, standing seams on 5 ft centers are required.

In order to be specific about the exact kind of construction required, it is merely necessary to refer to the proper plate numbers. If a set of plans includes duct sizes through 60 in., and an engineer does not require cross break construction, he specifies as follows: "All ducts shall be constructed in accordance with plate numbers 6, 7, 8 and 9 of the SMACNA Duct Manual."

Check-Sheet To Be Issued

I have been advised by one of the members of the Duct Manual Committee that this shortcoming has been recognized. The committee plans to issue very shortly a check-sheet which will point out the specific items which require a definite decision and statement on the part of the specifications writer. When available, this check list will be published in a future issue of Heating, Piping & Air Conditioning. This list should add materially to the usefulness of the manual.

There probably are some details required by engineers that are either not covered by the manual or that are in the manual and not acceptable to the engineer. Naturally, in this case, he proceeds as he has in the past. As stated before, this manual is not a cure-all. But it is a step in the right direction, and when used properly should be of great assistance to all of us.

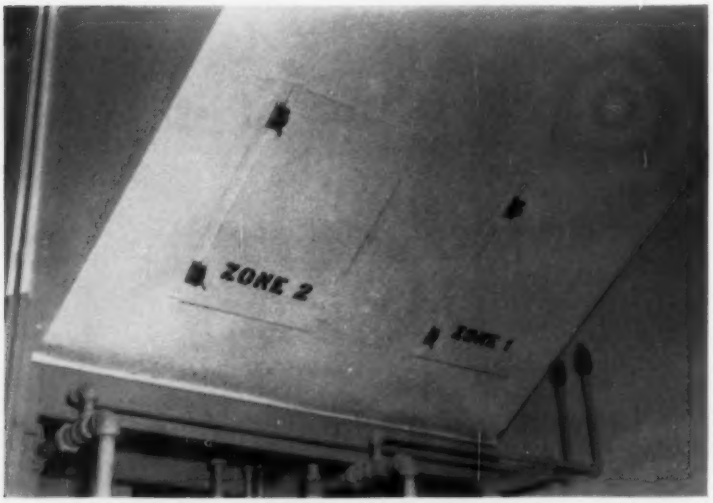
SMACNA's Future Plans

It might be well to close this series of articles by mentioning some of the future plans of the Sheet Metal and Air Conditioning Contractors National Association:

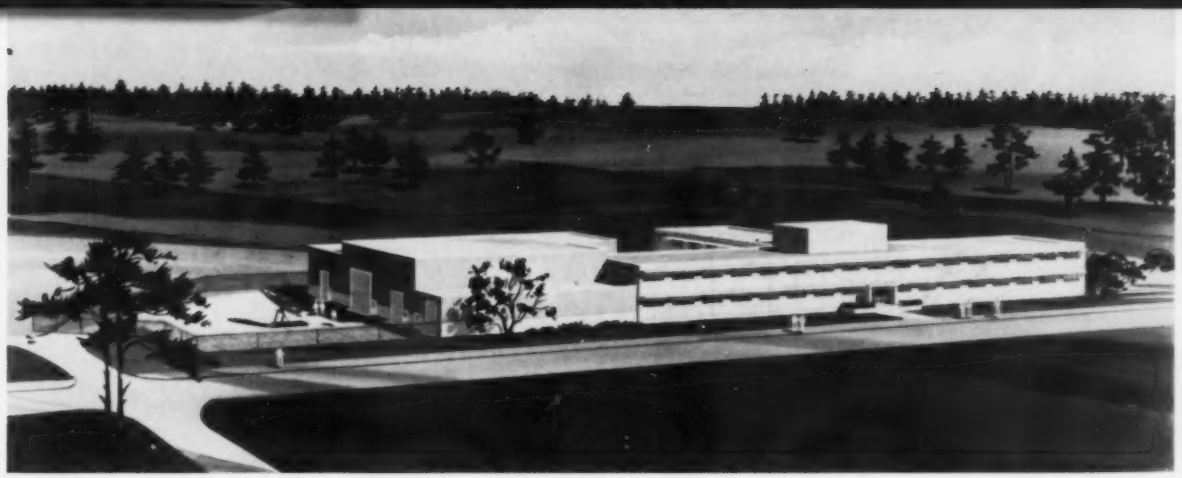
Section I of the Duct Manual, which covers "low velocity and low pressure systems" will be kept up to date by the issuance of additional or revised plates and text from time to time. In addition, Section II, covering duct construction for high pressure systems, is now being developed, and it is anticipated that it will be ready for publication by the end of 1960.

Copies of Section I can be obtained by writing the association, 107 Center St., Elgin, Ill.

It is very gratifying to know that there is an organization in our industry that is contributing so much to the principles of quality workmanship. I want to express my thanks to Henry J. Couch, secretary of the Ventilating and Air Conditioning Contractors Association of Chicago, for his help in making suggestions for these articles. ∓



ACCESS DOORS should be installed into ducts at all fire dampers, reheat coils, automatic dampers, and for access to clean interior of ducts. Where called for, furnish test openings with covers for taking readings of air velocities or pressures in ducts



Decide to Completely Air Condition New Navy Guided Missile School

• The decision to air condition the Navy's new Guided Missile School at Dam Neck, Va., was based upon the proposed year 'round use of the facilities and the fact that Weather Bureau data indicated that 2000 to 2500 hours would be experienced during the six warmest months of the year in which the wet bulb temperature would be 67 F or greater. Applying the Bureau of Yards and Docks zoning classifications, complete air conditioning was justified and installed at a cost of about $775 per ton of cooling capacity. The author explains the reasoning behind the decisions and how the system was designed and installed.

A self-educated registered professional engineer, Mr. Gusler gained experience in his early working years as a mechanic, construction electrician, and power plant operator. After World War II he served as a plant engineer, during which tenure he modernized several wood burning power plants and was instrumental in the design and construction of three automatic steam-electric generating plants utilizing wood and coal as fuels. In 1951 Mr. Gusler joined Watson and Hart, consulting engineers, as a design engineer. Since 1954 he has been an associate of Clark, Buhr & Nexsen in his present capacity. He is a member of ASHRAE, NSPE, and SAME.

BY DENARD L. GUSLER
Head
Mechanical-Electrical Dept.
Clark, Buhr & Nexsen
Architects-Engineers

ADVANCE PLANNING under a contract administered by the Bureau of Yards and Docks, U.S. Naval Dept., provided for a Guided Missile School at the Fleet Air Defense Training Center, Dam Neck, Va., for the instruction and training of officers and enlisted men.

The building was to be of a permanent type, with the main school section constructed of reinforced concrete and the laboratory built of structural steel with insulated metal panel walls.

To properly develop the project, field surveys were conducted and consultations held with the operational staff of the Navy. Existing conditions were thoroughly analyzed and studies were made to determine requirements on which designs and estimates could be predicated.

The building, as planned, contemplated the provision of a central air conditioning system to serve the laboratory and shop areas. A low pressure steam system utilizing finned radiation was to heat the classroom section.

Construction costs were estimated at $1,089,307, of which $105,119 was apportioned for air conditioning and $31,734 for heating and ventilating. During the period in which the advance planning was under consideration by governmental agencies the architect-engineers were asked to evaluate the economic feasibility of providing air conditioning for the remainder of the building. This request was generated by the necessity of operating the school during the summer months and current criteria for air

conditioning as published by the Bureau of Yards and Docks.

The criteria is based upon U. S. Weather Bureau data which indicates the number of hours that the Norfolk area will be subjected to wet bulb temperatures of 67 F or greater during the six warmest months of the year. With the area experiencing 2000 to 2500 such hours each summer, the installation fell into the Bureau of Yards and Docks' "Zone B," requiring mechanical refrigeration for all classroom areas.

The method by which this determination can be made as to whether or not a building for a specified purpose shall be air conditioned completely, equipped with evaporative cooling, provided with dehumidification only, or with mechanical ventilation requires knowledge of the four zones as follows:

Zone A: Areas where the wet bulb temperature is 73 F or higher for less than 160 hours during the six warmest months of the year and the dry bulb temperature is 93 F or higher for 155 or more hours during the same period.

Zone B: Areas where the wet bulb temperature is 67 F or higher for 1000 or more hours during the six warmest months of the year, provided that the area does not qualify under Zone A.

Zone C: Areas where the dry bulb temperature is 80 F or higher for 400 or more hours during the six warmest months of the year.

Zone D: Areas where the dry bulb temperature is 80 F or higher for less than 400 hours during the six warmest months of the year.

Next, the type of classroom and the zone in which it is located will set forth the manner in which comfort is to be provided.

	Weather zones			
Classrooms:	A	B	C	D
For specialized training where temperature and humidity control is essential	AC	AC	AC	AC
General classrooms	EC	AC	AC	MV

where: AC is complete air conditioning
EC is evaporative cooling
MV is mechanical ventilation

It was estimated that the additional funds required for air conditioning the entire building would be $48,000, which would make the cost per ton of air conditioning capacity about $775. The additional cost above the estimated cost was caused by much more electronic equipment added after the first plans for the building had been completed.

Preparation of contract plans and specifications was started with authorization to provide a complete system of air conditioning. The final cost for the complete air conditioning, heating, and ventilation system was $215,000, or a total of about $79,000 more than originally estimated.

Need Two Equipment Rooms

Two mechanical equipment rooms are provided, one a two-level room located at grade adjacent to the main shop spaces. The lower level of this facility contains a centrifugal water chiller rated at 274 tons of cooling capacity, capable of handling 589 gpm of chilled water at 42 F leaving and 53.2 F entering. This level also contains related auxiliary equipment, including a chilled water pump rated at 589 gpm, 150 ft head, 36 bhp and a condenser water pump rated at 822 gpm, 84 ft head, 23.6 bhp.

The upper level room houses air handling units for air conditioning systems Nos. 3 and 4. System No. 3 is rated at 19,910 cfm (minimum outside air is 1235 cfm), 626,137 Btu per hr gross total heat, and 7½ bhp. No. 4 is rated 30,261 cfm (minimum outside air is 3695 cfm), 721,036 Btu per hr GTH (gross total heat), and 10 bhp.

Since air conditioning was not included in the advance planning stages it was necessary to locate the second mechanical equipment room on the roof of the buildings in the central area of the classroom wings. If the room had been included in the earlier planning, it would have been integrated within the basic structure. However, the roof mounted location was mechanically feasible and proved to be an economical solution, considering the overall problem that needed to be solved.

This second equipment room contains the air handling units for air conditioning systems Nos. 1 and 2. System No. 1 is rated at 24,355 cfm, (minimum outside air is 4310 cfm), 604,085 Btu per hr GTH, and 10 bhp, while No. 2 is rated 23,695 cfm (minimum outside air is 3085 cfm), 588,283 Btu per hr GTH, and 10 bhp.

Each of the air handling units is a field erected unit equipped with outside air intake, filter section, preheat steam coil, chilled water coil, and single inlet fan mounted on vibration isolation units. All units have walk-in access doors, automatic dampers, and drain pans. All systems are low pressure.

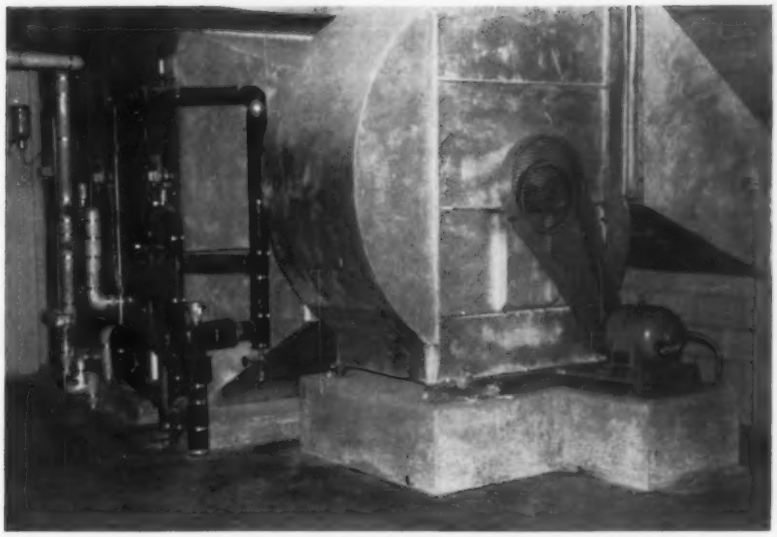
Each air handling unit is operated at a constant leaving air temperature controlled by a three-way valve on its chilled water coil. This valve is controlled by a capillary thermostat with its sensing element located in the fan discharge. It is set to maintain a 57 F leaving air temperature.

Each exposure of each floor in the classroom wings, where occupancy is reasonably constant and similar, is controlled by a reheat coil at the fan discharge on its respective system and a thermostat located in the conditioned space. Each shop and laboratory where electronic loading and occupancy is variable is controlled by a reheat coil at the conditioned space or at the fan discharge for its respective system. Controlling thermostats for all steam reheat coils are located in the conditioned spaces.

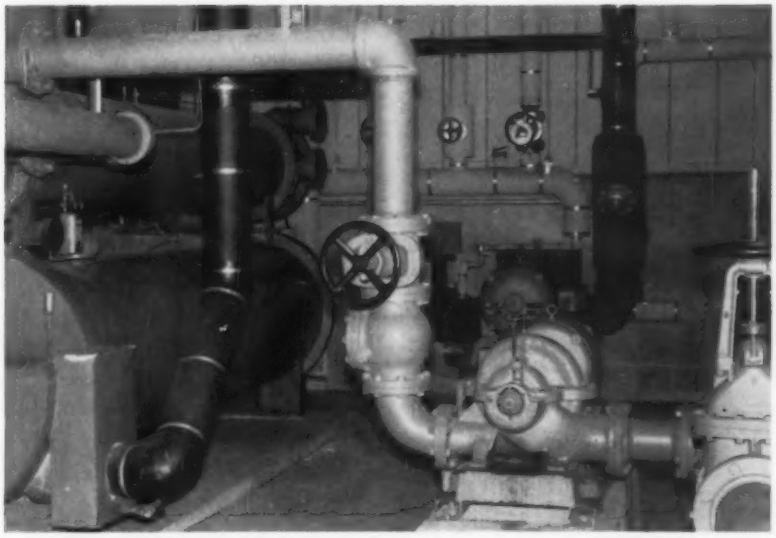
In addition, each air conditioning system is provided with a normally-closed minimum outside air damper, normally-closed maximum outdoor damper, normally-open return air damper, and normally-closed relief air damper. In each system these dampers are controlled by a dry bulb thermostat with its sensing element in the mixed air stream set at 57 F DB and a wet bulb thermostat with its sensing element located in the outdoor air stream set at 67 F WB.

Thus, when outdoor air will satisfy space conditions, the controls will function to admit outdoor air and reduce the load on the refrigeration compressor.

Ductwork for the classroom wings is run in furred corridor spaces with sidewall supply outlets that throw the air to opposite exterior walls. In other spaces, such as shops and lab-



FIELD ERECTED casing and fan for air conditioning system No. 3 illustrated at right. System is rated 19,910 cfm



CONDENSER WATER PUMP is located adjacent to chiller-condenser. Chilled water pump is in background

oratories, ductwork is run exposed at the ceiling, with conical diffusers for air distribution.

Steam for all heating coils is supplied through reducing stations connected to the station high pressure distribution system. Condensate is pumped back to the heating plant.

How Controls Operate

The chilled water pump motor starter has an auxiliary contact which, when closed, permits a pneumatic-electric switch to operate when actuated by the chilled water return temperature.

Closing the pneumatic-electric switch starts the lubricating oil pump on the centrifugal water chiller unit through a differential oil pressure switch. When the oil pressure is established, the water chiller motor is placed in operation. When the condenser water rises above a preset point, a temperature controller causes the cooling tower fan motor starter to be energized from the pneumatic-electric switch circuit.

The centrifugal water chiller is controlled by a pneumatic damper operator connected through linkage to prerotation vanes in the suction connection to each stage of compression. The temperature actuated pneumatic system will provide continuously variable capacity from 100 percent down to 10 percent of full load. A load limiting current transformer supplements and overrides the temperature controls to limit motor current to 110 percent of nameplate rating.

Architects-engineers for the building were Clark, Buhr & Nexsen. E. K. Wilson & Sons was the mechanical (heating, piping, and air conditioning) contractor. The contract administrator was the officer in charge of construction, Fifth Naval District, U.S. Naval Air Station, Norfolk. ±

Check All Cost Factors When Selecting Fuels

. . . for industrial heating systems

BY CHARLES RAND STEELE
Heating Consultant

• Careful consideration of all factors influencing cost is necessary when selecting either gas, oil, or coal heating systems. Such an analysis is mandatory if the plant is to provide optimum performance at the most economical fuel cost. In summary, the following points are factors that will apply to most sections of the U.S. and Canada, where heat is required in industrial areas for a substantial portion of the year:

1) A study by a competent engineer should precede the selection of fuel for every building.

2) A properly designed modern boiler plant can be "automatic," smoke-free, and efficient, regardless of the fuel selected.

3) Provisions should be made to keep the plant in operation without fuel deliveries for a reasonable period of time. It is understood that storage need not necessarily be within the building.

4) As far as possible, boilers and furnaces should be installed that are adaptable to easy conversion in future years, should the fuel availability or price structure change.

5) Comparisons of initial costs, maintenance costs, and operating costs for heating plants that are actually similar will ordinarily disclose the differences in these expenditures over the life of the boilers and furnaces. But these comparisons are usually insignificant.

Mr. Steele received his higher education at Cambridge University's College of Advanced Engineering and at Queens' College Oxford University in England. On completion of his studies in 1951, he joined Briggs, Briggs & Briggs, Ltd., London, as a design engineer. Three years later he was appointed chief field engineer and given full responsibility for all field operations.

INDUSTRIAL plant heating systems and the departments necessary for their operation and maintenance are frequently looked upon by business executives as necessary evils. In some instances the expenditures to carry on these departments seem to be regarded as more evil than necessary.

The purpose of an operating heating system is, of course, to provide workers with an atmosphere in which they can be as receptive as possible to producing the largest amount of work units.

The items that together make up a condition that will permit full concentration on the job at hand are both many and different. Each has an importance which depends on the particular situation. In a climate such as we have in our northern regions, where the heating season extends from October to June, supplying adequate heat to industrial buildings is one of the most essential, as well as one of the most expensive, items of plant operation.

A discussion of the possible sources of heat cannot well be based on the degree of comfort attained, but must be primarily directed as a comparison of cost factors. Much conflicting information is circulated constantly by the proponents of the use of the various fuels. The net result, in many

cases, is to leave the administrator with the opinion that the differences in costs are negligible.

Although a condition may exist in some localities that the cost differential between two or more fuels is very small, the opposite condition is the more usual.

Plant Saves $12,000 Annually

To illustrate the amount of money that can be involved in a fuel selection, operation of an actual system in a large heavy manufacturing plant amounted to something over $16,000 a year. Computations based on actual operating experience and on fuel prices being paid at the present time indicate that the cost of operating this plant with the most nearly competitive fuel under similar considerations would have been $28,300. This would be an annual increased expense of roughly $12,000.

It is expected that this system will remain in operation without replacement for at least 30 years. The assumption of a constant fuel price ratio over this period gives a total saving of $360,000 due to the proper fuel choice.

The necessities for a thorough investigation and careful selection of fuel to be used in manufacturing structures can be summarized in three points:

1) To obtain the true picture of any fuel cost, comparison must be extended to cover the life expectancy of the fuel burning equipment.

2) The factors involved in the selection of fuel warrant a separate decision for each location, each building size, and for each change in fuel price.

3) No difference in fuel characteristics is normally of great enough importance to eliminate the need for consideration of all factors and a decision on an overall cost basis.

The starting point for the choice of the proper fuel for any system must obviously be a survey to determine what fuels are reasonably available in the area.

The early one-man plant located on its own wooded lot had no problem in fuel selection. This situation, or one very similar, exists in many localities today. The presence of coal mines or gas wells, or the availability of certain fuels in certain districts, simplifies the selection problem.

However, regardless of the choice of fuel, a condition can arise which may temporarily halt the fuel supply. In view of the fact that loss of heat production will affect an immediate similar occurence in the industrial plant, adequate precautions should be taken against such an eventuality.

With oil, or with coal, storage facilities for a reasonable supply should enable the plant to weather any shortage that will not cripple the entire community. With gas, however, storage is not practicable and consideration should be given to dual-fired boilers with standby storage of another fuel.

Another type of emergency is the failure or malfunction of the fuel burning equipment itself. Here, the possibility of maintaining heat by hand firing, by the use of natural draft, etc., gives the coal fired boiler a slight advantage over those using gas or oil.

Weigh Long Range Prospects

Any decision based on today's computations must be conditioned by future prospects. Various long range trends that will have an influence on future fuel supplies and prices can ordinarily be detected and should be taken into consideration. Some examples that seem to be visible at this time are:

1) The demand for coal for export that began in 1955-56 seems to show signs of continuing to push the price higher for some time to come.

2) The conversion of refineries to the petroleum coke process seems to have been slowed by the falling price of coke. Many refineries have installed this process, however, and as markets are developed for coke, supplies of residual fuel oil will again become difficult to locate in some areas.

3) The construction of new pipelines, discovery of new fields, etc., make the prospects for cheaper and more available natural gas very good. The price picture, however, is somewhat clouded by possible legislation and by the growth of the petrochemical industry to compete for gas.

You Get What You Pay For

As a starting point in considering how the required capital investment affects the fuel selection for a building, we may best quote the old saying, "You get what you pay for." Low cost equipment for utilizing each fuel is available, but is seldom the best choice.

In a new building, where no limitations are imposed by existing conditions, the comparison can be directly between available fuels. Care should be taken in comparing installed costs, however, to see that the equipment is actually similar.

Estimates should be based upon boilers with the same heating surface, within reasonable limits, in order to make a fair analysis. Each fuel burner must be equipped with the necessary controls to make operation not only automatic but safe. The prices obtained for boiler and fuel burning units, by such a comparison, will ordinarily vary only slightly.

Gas and light oil burners show somewhat of an advantage in the area of fuel handling, because they do not require preheating as does coal or heavy oil. The extra cost of coal and ash handling equipment required to make coal firing automatic must also be scrutinized.

However, the installed costs of tank facilities for the storage of a reasonable supply of fuel oil are generally somewhat higher than the cost of bin facilities for the same storage of coal. Common practice has been for the construction of storage areas for a somewhat larger supply of coal as compared with the supply of fuel oil. Gas, of course, does not lend itself to storage and this cost is eliminated.

Consideration should be given, however, to the added cost of a dual-fired plant with a stored supply of coal or oil, as previously mentioned, if interruption of the gas supply is a possibility. Dual firing would tend to eliminate the initial cost advantage of a gas system in this area.

Consider Future Conversion

Regardless of the selection, the equipment should be chosen with the consideration of the possibility of conversion at some future date to one of the other fuels. Along this line it may be pointed out that, in the case of conversion, coal storage areas can frequently be used for other purposes.

For natural gas the cost of installing piping from the mains is usually the responsibility of the owner and must be added to the overall cost of the firing equipment, together with the cost of a meter room if one is required.

The considerations discussed in connection with new buildings are applicable to the replacement of obsolete heating plants in existing plants with a few minor exceptions.

At the present time, the majority of the heating plants being replaced are coal fired with a minimum of coal and ash handling equipment. With current labor costs, the elimination of much of the hand labor is justified, and the cost of a coal installation that is reasonably automatic should be used for comparison with installed costs of a replacement oil or gas system.

The modernization of a heating plant in an existing building with an adequate coal storage area gives a capital cost advantage to modernization with coal. An analysis of fuel prices is still indicated, however, and it should be affected by the initial outlay to the extent of the amortization of the difference in the capital cost.

Some consideration in the selection of replacement equipment should be given to the fact that existing buildings ordinarily have existing stacks that may well eliminate the necessity for induced draft fans that are often included in packaged units.

Initial Costs Are Deceiving

Difference in initial costs are frequently given more weight than they are actually entitled. The cost of fuel, however, becomes a high annual expense even for a small plant. As in the example previously given, the difference can amount to $10,000 to $12,000 annually for a single building.

A unit of comparison is needed for the second and probably most important phase of the selection, the determination of the actual cost of the fuel. Chicago factories are currently paying $10.23 a ton for 14,200 Btu per lb coal, $0.0995 per gal for 146,000 Btu per gal oil, and $0.0770 per cu ft for 1000 Btu per cu ft natural gas. This sounds like a comparison of apples, oranges, and pears, but upon equating them to cost per 1 million Btu, the comparison becomes:

Fuel	Cost per million Btu, $
Natural gas	0.770
Bituminous coal	0.360
No. 5 oil	0.681
No. 6 oil	0.589

This indicates strongly that, in this particular area, consideration must be given to the possibility of using coal. No. 6 fuel oil is the most competitive fuel, at a 64 percent higher cost. But difficulties involved in starting its flow impose some additional problems that can be solved by preheating the oil. Because of this, No. 5 oil is selected where preheating is not feasible.

Another alternative that is finding wide acceptance in some areas is the use of combination gas and oil burners. Natural gas is used as the main fuel on an interruptable basis down to 10 or 20 F, set by the local utility after determining the load and supply. Below these temperatures or when the gas supply is low, fuel oil is used. The cost for gas on this basis is generally very favorable.

Combustion Efficiency Varies

The first factor that arises to cloud the issue of a direct cost comparison is that of combustion efficiency. Various agencies will quote efficiences of 80 to 85 percent for their product to be compared with 45 to 65 percent efficiences for other fuels. Obviously, the prices quoted are for the heat units delivered to the building and only those that can be utilized can be of value.

Under laboratory conditions it is possible to obtain as useful heat some 80 to 90 percent of the fuel heat content, regardless of the fuel used. On smaller units, however, the higher test efficiencies are more easily obtained on gas and oil.

Of importance to the consumer are the actual results that will be obtained in his plants on a seasonal basis, with difference in operators, fuels, etc., taken into consideration.

Little information on this subject is available, but a recent study made in Detroit seems to approach a reasonable result. Five oil burning plants were selected for which fuel delivery records were complete and consumption uncomplicated by recent building alterations or other unusual circumstances. These buildings were

Operating and maintenance costs must be considered in the overall analysis

compared with five modern coal burning factories of the same sizes, constructed during the same period, and using the same type of insulation.

Equating these structures on a cubical basis, it was discovered that the average coal consumption was 0.464 lb of coal per cu ft per year, as compared to 0.0421 gal of No. 5 oil. From this it was possible to obtain a fuel cost at current prices of $2.373 per 1000 cu ft annually with coal, and $4.188 with oil.

From these studies it was determined that the average seasonal efficiency with modern coal plants was 70 percent and the efficiency of the oil fired plants was 75 percent.

This compares to a study made in 1952 where stoker fired steel heating boilers at 150 percent of nominal rating gave efficiencies of 70 percent, while efficiencies with oil were 73 percent.

It must be pointed out that these Detroit efficiencies were computed on figures from coal stokered plants without modulating controls and from oil plants using rotary cup burners with modulating controls. The efficiencies should be quite close in a comparison of buildings where coal fired boilers also have the advantage of having modulating controls.

The seasonal efficiency of gas is ordinarily not assumed to be better than that of fuel oil, giving the administrator little that will affect a cost comparison.

Operating Cost a Factor, Too

In addition to the amortization of the initial investment and a fuel cost, another factor with a bearing upon the decision is the annual operating cost.

Power requirements for heavy oil burners of the various types and of stokers are quite similar. With natural gas power burners the cost is quite a bit lower. It is doubtful, however, that the power requirement cost differentials would exceed $200 annually in an average plant or would be a major factor in a decision on a large industrial heating plant.

Wage Savings Are Poor Basis

The possible savings in manpower provided by automatic gas or oil heat is, perhaps, the largest factor in the arguments of those who consider that fuel prices are not a conclusive basis for cost comparisons. Adding wages to the computed fuel cost on one side of the balance, or deducting them from the other, seems a ridiculous procedure but is quite common.

With a work year of 2080 hours, the period in which heat is not required should give any operator some 700 hours in which he has no operating duties in the boiler room. Of the remaining 1400 hours, with automatic heat of any type, the man may be required to be in the vicinity of the boilers and the heating plant to maintain mechanical equipment.

It seems reasonable to believe that a conscientious operating engineer should check his boilers at intervals during the day, using some five hours weekly for about 35 weeks of the year for this safety measure. With stoker fired coal, another five to 10 hours weekly might be required to break up fires and take out ashes. This gives a differential of 350 to 400 hours pay annually that can reasonably be charged to the difference in fuels.

Hard to Compare Maintenance

A very difficult assignment is the estimation of maintenance costs involved with the various fuels. It would seem that natural gas has a great advantage here over the others, but it is hard to determine the amount of this advantage in annual dollars — particularly where modern controls are involved.

Stoker iron is quite expensive and is subject to the need for periodic replacement. Much of this work, however, is unskilled and can be done by the operator at no additional labor cost. Control difficulties, particularly in the more complicated gas and oil burner circuits, require the services of specially trained men.

The answer to cleanliness in a building and to the elimination of smoke lies in good design and good operation of a plant rather than in the fuel. Gas, of course, is almost foolproof in this area. Coal and, to a lesser extent, oil are subject to difficulties caused by carelessness. Properly treated and carefully delivered coal will cause no problems in cleanliness, and proper combustion chamber design and coal selection will eliminate any difficulties with smoke.

Heavy oil burner installations are somewhat of a problem to design and adjust because of the variance in oils delivered from month to month. Good operation and adjustment are important to maintain efficient firing without soot, but, with attention by the operator to changing the adjustments upon receipt of oil shipments, smoke and cleanliness need never be a problem. ≠

New Nuclear Center Demands Precise Air Conditioning Systems

The close temperature and humidity tolerances, air cleanliness, and health of personnel required in the development and manufacture of nuclear fuel elements at Combustion Engineering's new $15 million nuclear center gave birth to a pattern of air conditioning systems ranging from the complex—where assembly of nuclear reactor cells requires negative static pressure, very clean air, and exacting control of air movement—to the conventional—where commonly used industrial systems provide year 'round heating and cooling to an employee cafeteria and administrative and business offices.

BY D. M. COLLINS
Building Service Engineer
Stone & Webster Engineering Corp.

SPECIALIZED NEEDS of an atomic facility have made air conditioning one of the prime design features of the Nuclear Engineering and Development Center built by Combustion Engineering, Inc. in Windsor, Conn.

Certain air conditioning features were of paramount concern in designing and building the center because the techniques required in studying the nuclear characteristics of reactor cores and manufacturing components are so highly critical from a temperature and humidity standpoint.

Because of the elements of air pressure, air temperature, and standards of cleanliness called for in the reactor cells themselves, the experimental laboratories and the manufacturing facilities have required a pattern of complex air conditioning systems.

Meeting the requirements of the Atomic Energy Commission for maintaining the health standards in a nuclear facility in relation to personnel within the center was essential. General safety standards also strongly influenced the design of the air conditioning systems.

Systems Vary with Needs

The design of the air conditioning system varies considerably from building to building depending on the specific requirements of the air control levels needed. At one extreme is the Advanced Critical Assembly Bldg. where the nuclear reactor cells require that all air admitted be passed through a submicron particulate air filter, and that the control of all air movement has to be exact. Also, a negative static pressure must be maintained in the building.

In some of the manufacturing, development, and laboratory facilities positive air filtration with provision for periodic sampling of air is required. At the other extreme, such as the cafeteria and business and administrative offices, only routine air conditioning to provide heating and cooling is called for through commonly used industrial systems.

In the Flexible and the Advanced Critical Assembly Bldgs., six separate air conditioning systems are used to meet the specialized requirements. Two are in the former and four in the latter.

The two different types of systems in the Flexible Critical Assembly Bldg. will illustrate the design characteristics of the air conditioning arrangements in these two Critical Assembly Bldgs.

One system is used for each critical cell housing a nuclear reactor. Equipment for each system is in a structure adjacent to the cell. Arrangement of the system is such that air is moved through the cell at the

AIR CONDITIONING DUCTS are seen at side of this partial view of core manufacturing plant at Combustion Engineering, Inc.'s new Nuclear Engineering and Development Center. Critical nature of work conducted in this area placed stiff requirements on air conditioning design

rate of 10 air changes per hr. Ten percent of the air introduced is outside air. Sixteen percent of the air moved through the cell is exhausted through submicron particulate air filters to the atmosphere. The difference between the amount of air exhausted and the amount of air introduced, or 6 percent, is by infiltration of air to the cell from the surrounding space.

Negative Pressure Inside Cell

This infiltration is assured by maintaining a negative pressure inside the cell through use of a static pressure regulator operating on the volume damper in the outside air duct. Maintenance of negative pressure within the cell prevents contamination of air in the control room and other adjacent facilities where laboratory testing is conducted.

This system also has an emergency exhaust fan of sufficient capacity to rapidly rid the cell of dangerous gases and dust. It is a manually activated unit and discharges to the atmosphere through a submicron particulate filter.

A supplemental outside air makeup duct of sufficient capacity to satisfy the demand of the emergency exhaust fan (less the air usually supplied through the air conditioning unit and that supplied by infiltration) is operated together with the emergency exhaust fan.

The prime equipment in this ventilation circuit for the critical cell is the package air conditioning unit. This unit is complete with integral compressor, evaporative condenser, air handling unit, fans, pumps, cooling coil, piping, and controls. It is sized to maintain 75 F (± 2 F) during the cooling season. This addition of an external heating coil in the outside air makeup permits this equipment to maintain these conditions during the heating season.

How Second System Operates

The second system in the Flexible Critical Assembly Bldg. serves the remaining areas in this structure. This system provides air conditioning for the control rooms which have a high heat release level caused by operation of vacuum tubes and other control equipment.

Sampling tubes in the air conditioning system allow air samples to be taken for periodic checking by the health physics group to check contamination levels leaving the system.

This system basically provides both comfort cooling in summer and year 'round ventilation. Its prime equipment is also a package air conditioning unit similar to the one used for the critical cell. It is sized to maintain 75 F (± 2 F) during the cooling season.

An external heating coil in the outside air makeup duct permits the use of this system for winter ventilation. The ductwork is arranged so that when the outside temperature is such that neither cooling nor heating of the outside air is required, 100 percent outside air is introduced into the system. This latter arrangement affords cooling by outside air during a considerable period annually.

Several different exhaust ventilation systems serve special areas of the Flexible Critical Assembly Bldg., such as the vault, hood in the storeroom, toilet room, boiler room.

Prevent Cross-Contamination

In the Advanced Critical Assembly Bldg., which is equipped with two reactor cells, there are separate air conditioning systems for each cell. This is to prevent cross-contamination be-

tween critical cells. Each system has the same features that are provided for the single cell in the Flexible Critical Assembly Bldg., except that in this building air handling units are used instead of complete package type units.

The remaining areas in this building are air conditioned via separate systems serving each of the two floors. The ductwork of these latter systems is arranged so that one zone serves the east exposure and another zone serves the west.

Each of the four systems in this building is supplied with chilled water from a central package liquid chiller located in the east air conditioning room. Condensing water for the compressor is provided by a cooling water circuit served by cooling towers in the yard.

In the Fuel Elements Fabrication Bldg. the air conditioning system in the manufacturing section has submicron particulate filters and sampling tubes. In the office wing of this building the air conditioning, ventilating, and heating systems are conventional. Direct radiation supplements the indirect systems in certain rooms.

In general, the supply systems heat or cool the air with centrally located equipment, and tempered air is supplied to window distribution boxes along the periphery of the building.

The Development Laboratory Bldg. has its ventilation air distributed to the various rooms from central supply systems. Each system serves a group of rooms within a definite area. The supply air furnished by each system is tempered in winter and cooled in summer.

Special air conditioning and ventilation systems for laboratories consist of a number of small central systems, each serving its special area. In general, these systems include filters, fans, and coils. For winter heating, one set of coils is served by 15 psi steam. A separate set of coils in these units is served by chilled water for summer cooling. Special exhaust systems, each provided with submicron particulate filters, serve "hot" areas.

Steam at 15 psi for winter heating is supplied by a reboiler located in the equipment room of the manufacturing area. Chilled water is supplied for summer cooling.

In addition, for other areas, electric motor driven recirculating air units are provided under windows along the sides of the building. The coils of the units are served by low temperature hot water for winter heating and chilled water for summer cooling.

HTHW Used in Absorption Unit

The low temperature hot water is generated in a high temperature to low temperature water converter located in the equipment room. The chilled water for both types of systems is supplied from an absorption refrigeration unit also in the equipment room. This absorber is activated by high temperature hot water and also supplies chilled water to the office section of the Fuel Fabrication Bldg.

In the Administration and Engineering Bldg., the air conditioning, ventilating, and heating systems are of conventional design. In general, mixing boxes are provided under windows. Each box is served by two supply air ducts, one warm and one chilled. Each duct leads from a central supply system where filtering, heating, and cooling coils are installed.

The distribution system serving both floors is in the ceiling of the first floor. Automatic temperature control is provided for each mixing box, and discharge air temperature will be under the control of the thermostats.

Steam for the heating coils for winter heating is supplied by a reboiler. The chilled water for summer cooling is provided by an absorption refrigerating unit. Both the reboiler and the absorber are located in the central equipment room.

The center was designed and built by Stone & Webster Engineering Corp. ≠

Nuclear Center Houses Many Functions

The center, representing an investment of $15 million, is located on a 530 acre tract and consists of five major buildings and supporting facilities. It provides laboratories for experimental developments bridging the gap between theory and practice in the use of nuclear energy for producing usable power. It also provides facilities for manufacturing fuel elements and "light" reactor components.

First to be completed were the Flexible Critical Assembly Bldg. and the Advanced Critical Assembly Bldg. Both these structures, designed for studying atomic nuclei and testing theories and observations concerning their behavior, house reactors.

The construction contract under which the center was built made it possible to complete construction on the first building even before engineering designs were finalized on the second. Within six months after ground was broken for the second building, the company's scientists had achieved a chain reaction in the first reactor.

Another structure is the Fuel Element Fabrication Bldg., used to manufacture fuel element assemblies and other reactor core components, such as reactor internals, control mechanisms, etc.

The Development Laboratory Bldg. is used to house facilities for physical, chemical, and metallurgical testing of materials used in reactor construction.

The Engineering and Administration Bldg. includes administrative, engineering and general offices, as well as the employee cafeteria for the entire center. Other necessary service structures such as garages, pump houses, and boiler rooms are centered in a special utility area.

SAMUEL R. LEWIS, consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally on practical problems in the field.

Sam Lewis says:

"Next Time I'll Inspect, Test Integrity Of Submerged Oil Suction Piping"

TWO FIRETUBE BOILERS in a very tall apartment house had furnished low pressure steam from electric-driven underfeed stokers over a period of 25 years. Inevitably, the old stokers and coal conveyors became weary and replacement was indicated.

The coal storage room was large and permitted two new fuel oil tanks to be welded in place. Oil replacement pipes were run through the basement wall for delivery of fuel oil from a truck in the alley. An existing natural gas service was easily connected as an alternate fuel.

The new pressure atomizing modulating burners are for preheated bunker C oil. A new, deeper refractory-lined, steel-encased furnace was installed under each boiler. Changeover from oil to gas is possible within minutes, so that gas can be used in summer when its rate is lowest. Automatic combustion control was installed and the plant went into service.

Either or both oil burners operated excellently until the oil level in tank "A" was lowered somewhat below half-way. Then sputtering and unacceptable combustion commenced. After switching the oil suction to tank "B," the trouble ended until the oil level in tank "B" was below its half-way point, when the same trouble appeared again.

The capacity of the oil pump and the adequacy of the oil heating were proved after several days of experimenting. The oil piping and joints and valves, where accessible, were all tested and proved tight.

Fuel oil of lighter quality was substituted. Regardless of the viscosity of the fuel, the burners worked if the tanks were nearly full and the burners went "berserk" when the tanks were only partly full. Many overtime hours' labor and good will were lost and the installation hovered toward rejection.

The leaks were found by pumping down the oil level until a courageous workman in rubber boots climbed down a ladder inserted through the tank manhole.

It appears that the suction piping extending down through the tops of the tanks to their bottoms had been inserted in sections after the oil tanks had been welded. There was not enough vertical clearance between the tops of the tanks and the fuel room ceiling to permit introduction of the suction piping in one piece. This piping was cut into several short pieces that were welded as they were pushed down into the oil.

The welding job was imperfect. When the top of the oil passed below a poorly welded joint, the oil pump no longer received oil, but instead received a mixture of oil and air with disastrous results.

Next time I have to do with a welded-in-place fuel oil tank, I'll inspect and test the integrity of the submerged suction piping. ∓

Sectional Committee Interprets Code for Pressure Piping

SINCE the Code for Pressure Piping, ASA B31.1-1955, was last issued, the Sectional Committee on the Code has been asked to interpret various statements contained therein. While these Cases represent the opinion of the committee, they will not become parts of the Code until formal actions have been taken. Among the subjects covered in these Cases are the use of nodular cast iron piping components in construction governed by Sections 1, 2, and 3 of the Code, and the requirements for high pressure fuel oil piping.

Case No. 38 (Reopened)

Inquiry: May piping components made of nodular cast iron and to the dimensions of ASA Standards B16.1, B16b, B16.5, and API 600 be used in construction under the jurisdiction of Sections 1, 2, and 3 of the Code for Pressure Piping (ASA B31.1-1955)?

Reply: It is the opinion of the committee that, pending the completion of studies now in progress in Sectional Committees B16 and B31, nodular cast iron components made of material conforming to ASTM Specification A395-56T may be used under the sections indicated in the inquiry under the following conditions:

1) Components whose dimensions conform to ASA B16.1, B16b, B16.5, and API 600 may be used at the following maximum pressure-temperature ratings at temperatures between −20 F and 650 F.

Dimensions used	Maximum rating
Class 125 cast iron (B16.1)	80 percent of 150 lb carbon steel
Class 250 cast iron (B16b)	80 percent of 300 lb carbon steel
150 to 600 lb steel, inclusive (B16.5 or API 600)	80 percent of carbon steel rating

These ratings are applicable to valves providing that the valves in other respects merit these ratings. It is recognized that components made to the Class 125 and Class 250 standards or to API Standard 600 may be thicker than those made to the 150 lb and 300 lb standards, respectively. In the case of these thicker components, the additional wall thickness may be considered as additional corrosion allowance.

2) Until further experience is developed, the pressure at operating temperature shall not exceed 1000 psi.

3) Welding is not employed either in fabrication of the components or in their assembly as a part of a piping system.

4) They shall not be used in lethal service.

Case No. 43

Inquiry: Paragraph 155, Section 1 of ASA B31 as now written appears unduly restrictive for high pressure fuel oil piping, in requiring that it be designated as for saturated steam at the operating pressure. May the design of such systems, using only steel components, utilize those components covered by B16.5-1957 at the pressure-temperature ratings given therein, using the actual fluid temperature as the design temperature?

Reply: It is the opinion of the committee that fuel oil piping using only steel components may be designed to utilize those components under the adjusted pressure-temperature ratings of B16.5-1957, using the actual fluid temperature as the design temperature. ∓

How to Size Gravity Roof Vents

By JOHN D. CONSTANCE
Mechnical Engineer

WHILE many industrial buildings today are being equipped with mechanical ventilation facilities of one kind or another, many are also provided with gravity roof ventilation, utilizing the natural forces of convection and the wind to ventilate their interiors. In this respect, the two most important factors are temperature difference between the inside and outside, and the flow produced by the wind. The purpose of this Data Sheet is to show how easily gravity roof vents can be sized.

When considering temperature differences alone, gravity roof ventilation depends on: (1) heat produced in the building; (2) vertical distance between inlet and outlet openings; and (3) areas of inlets and outlets. Relative values of inlet to outlet areas also have direct bearing on the effectiveness of gravity ventilation.

For low buildings 10 to 15 ft tall, the wind is the chief force used in ventilating by natural means. However, as ceiling heights increase, the thermal head or temperature difference has the more predominant role. Buildings in which the manufacturing process produces little heat must depend almost entirely on the wind for natural ventilation.

For a given vertical distance between openings and a given temperature difference (usually 10 F), the outlets high in the building will exhaust a given amount of air. Opening locations are set by the building dimensions. The amount exhausted can be determined by use of the following empirical equation:

$$Q = A\,[10.82\,\sqrt{H\,(t_i - t_o)} + 30.83\,V] \text{ cfm}$$

where:

A = vent opening area, sq ft
t_i = inside average temperature, F
t_o = outside design summer temperature, F
V = wind velocity, mph

By means of this equation, it is possible to predict the ventilation rate from temperature and vertical height measurements. If the area of the outlet exceeds that of the inlet or vice versa, then a correction factor must be applied.

Normally, the amount of air to be exhausted is known from tables or experience and the problem is centered around finding the vent opening area (A in the equation). Once found, the low level inlet area may be checked or selected, depending on whether windows or louvered openings are used.

In order to simplify the selection the intersect chart (Fig. 1) has been developed based on a $t_i - t_o$ equal to 10 F (which is considered safe practice, taking into account windless days). To use the intersect chart, you must know: (1) the length, width, and height of the room; (2) the vertical distance between inlet and outlet openings; (3) air changes required (see standard handbooks on ventilation); and (4) the wind velocity.

From the first requirement above, the room cubage (A) is found. Then, using the chart, find the cfm of outside air (B) or free vent opening (C). Increase in air flow handled due to wind effect can be found from the graph included with Fig. 1. Suppose, for example, a garage needs 10 air changes per hour for ventilation. Its dimensions are 50 ft × 100 ft × 15 ft high; the vertical distance between window inlets and roof vent outlets being 13 ft and the total window opening area being 500 sq ft. Assume a wind velocity of 2 mph. Find the roof ventilator area required.

Cubical contents of the building (A) is 50 × 100 × 15 = 75,000 cu ft. Since the cubical range on scale (A) is limited, base the use of Fig. 1 on 15,000 cu ft and multiply (C) by 5 (75,000/15,000). Now, read over to air changes per hour (10), and vertically up to (B). The cfm required (15,000 cu ft basis) is 2500. Read up to L = 13 ft and over to the right to (C) and read 20 sq ft. The total roof opening area is 5 × 20 = 100 sq ft. Use this area in selecting the number and size of roof vents.

The insert chart showing effect of wind can be utilized to account for additional cfm exhausted. This latter holds for roof vents only. By trial and error, the size of roof vent area may be reduced according to wind effect. We cannot use wind effect for louvered openings, high or low.

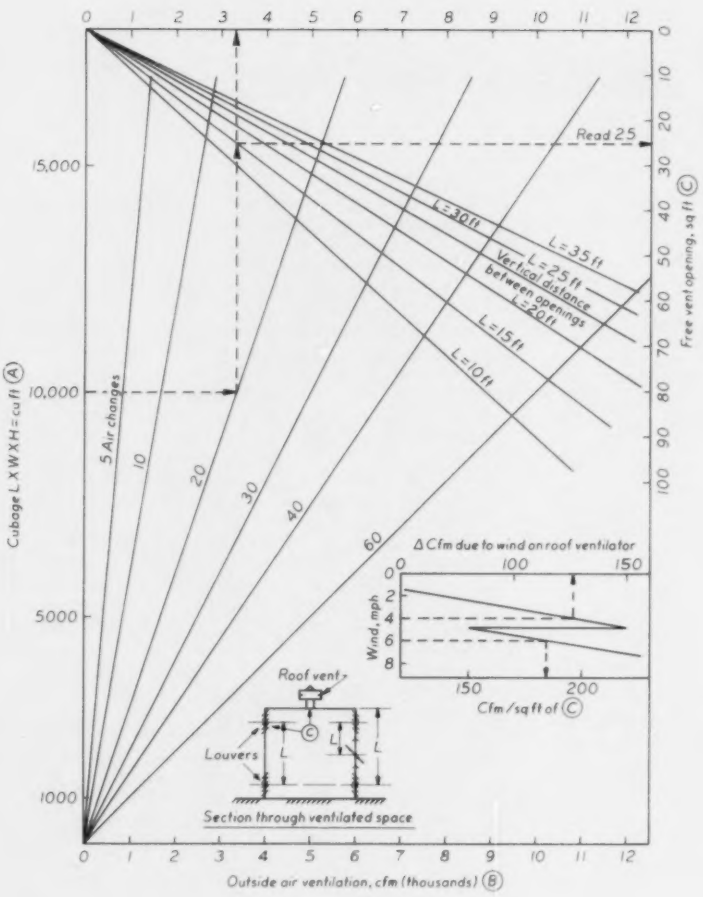
If five vents are selected, the size would be 60 in. in diameter, or an area of 19.63 sq ft each. Wind effect would be 30 cfm × 19.63 × 5 = 2950 cfm. Using the 60 in. diameter vents would result in exhausting 2500 × 5, or 12,500 cfm without wind effect. The additional capacity achieved would only add to the ventilation rate.

Try five vents at 54 in. in diameter (15.9 sq ft). Refer to Fig. 1 and read back from (C) equal to 15.9 to L equals 13 ft and read 1800 cfm on (B).

Cfm flow convection only 1800 × 5	9,000
Cfm wind effect only	2,400
Total	11,400

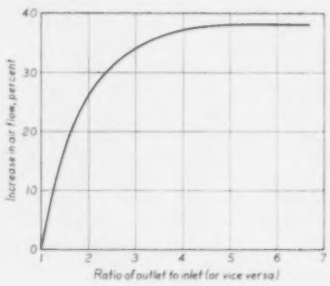
Since the flow need is 12,500 cfm, let's see the effect of area factor. This is determined by use of Fig. 2. The factor is 500 (window area)/(15.9 × 5) = 6.3. Read Fig. 2 to give a 38 percent increase in flow. Thus, the total flow taking into account all factors is 11,400 × 1.38 = 15,700 cfm. This is excessive. Try a further size reduction by exploring 48 in. diameter vents.

HPAC DATA SHEET



1 **TO SIMPLIFY SIZING** gravity roof vents, chart at left has been developed based on inside average temperature-outside design summer temperature difference of 10 F. To utilize chart, user must know room dimensions, height between inlets and outlets, air changes required, wind velocity. Text explains how to use it

2 **AREA FACTOR** chart below relates increase in air flow to outlet-inlet ratio



Five 48 in. units (with an area of 12.57 sq ft each) will have a flow of 1500 cfm on (B) by referring to Fig. 1 and reading back from (C) of 12.57 to L equal to 13.

Cfm flow convection only 1500 × 5	7500
Cfm wind effect only 30 × 12.57 × 5	1880
Total	9380

The area factor is still 1.38, so that resulting flow is 1.38 × 9380, or 13,000 cfm. This is slightly in excess of the required 12,500 cfm and is the final selection. Therefore, use five 48 in. diameter vents.

Using louvers high in the side walls would have a value of L equal to, say, 10 ft and no wind effect. From Fig. 1 a total of 23 × 5 = 115 sq ft of louver net area would give the required flow. Then, with a constriction coefficient of 0.7, the gross louver area would be 115/0.7 = 164 sq ft.

Cfm convection only 2500 × 5	12,500
Cfm wind effect only	none
Area factor effect 12,500 × 1.38	17,200

This is excessive, so try 15 × 5 = 75 sq ft net area:

Cfm convection effect only 1700 × 5	8,500
Cfm wind effect only	none
Area factor effect 8500 × 1.38	11,700 cfm

This is slightly short of the required 12,500 cfm. But, considering all aspects, the area selected can be used without penalizing the flow conditions. The gross louver area would be 75/0.7 = 107 sq ft. Louver height openings should be not less than 12 in.

The effect of altitude on confined convection currents is to decrease air density of the ambient system. This will affect draft to a degree, but can be neglected in work of this nature and in altitudes up to 5000 ft above sea level. ⧺

Intestine Washing Damage Cut By Thermostatic Water Controls

RATE OF FLOW is adjusted by employee before filling operation of long processing tanks begins. Control (top of picture) is capable of supplying 40 gpm. It maintains constant temperature regardless of fluctuations of water temperature or pressure changes in supply line

BY J. W. MONTPLAISIR
Project Engineer
Ethicon, Inc.

WASHING animal intestine to be used for a variety of products can be troublesome if the water temperature isn't closely controlled. Should the water get too hot, the intestine may be cooked. If it gets too cold, mucus will not be thoroughly removed.

This was the problem faced at the Chicago plant of Ethicon, Inc., manufacturer of surgical sutures. Its system of manual water controls was resulting in too many damaged intestines.

By switching to thermostatic water controls in its washing machines, the company cut damage due to water temperature variations by 100 percent. At the same time, the new controls eliminated delays in getting the right temperature while the processing tanks were being filled.

Temperature changes caused by water turned on and off in other parts of the plant was the biggest problem with manual controls. This problem cropped up in cleaning machines and during the filling of processing tanks, both of which require a constant temperature.

Using hand valves, plant personnel could not keep pace with constantly fluctuating temperatures. The thermostatic water controls that were installed will automatically maintain the water temperature within 1 F.

The controls are designed to compensate automatically for any variations in supply water temperatures or pressures.

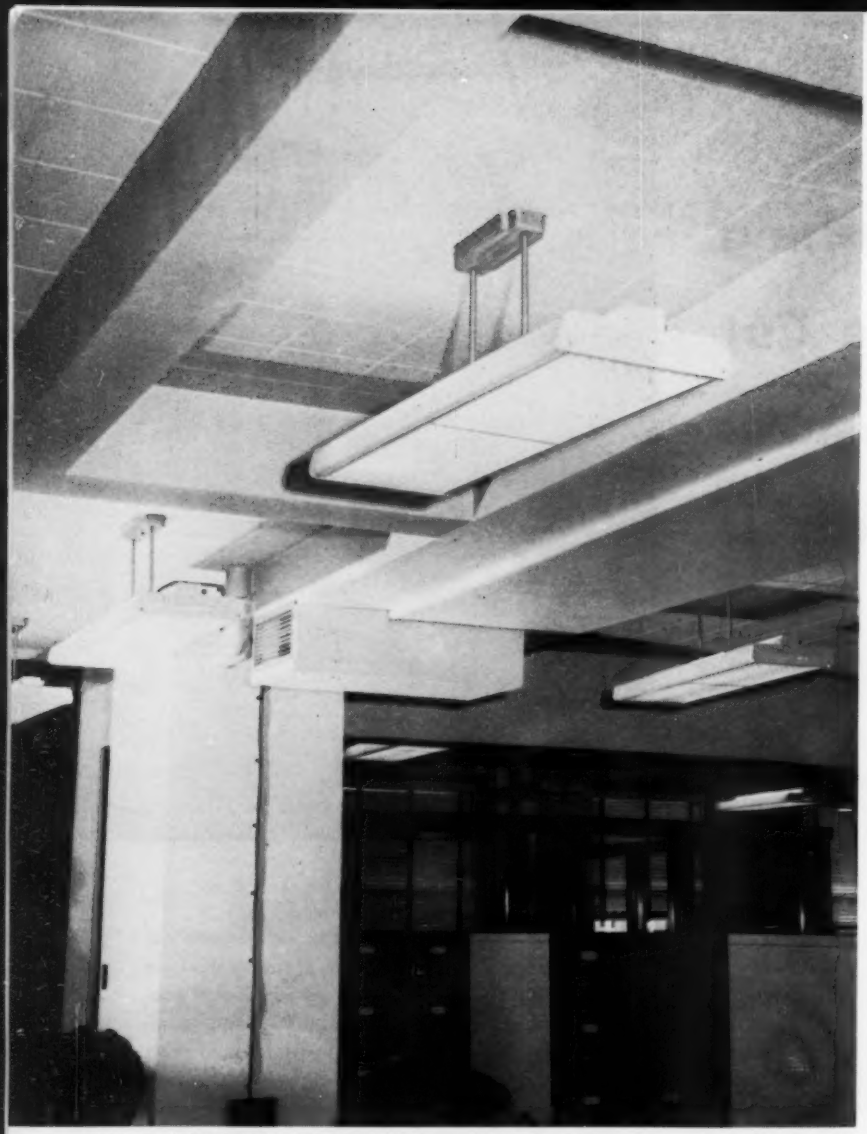
An individual control serves each machine. The intestines, which have already been cut into long strips, are passed through the water spray in the machine by a system of rollers. Water flow rate is 10 to 20 gpm. After the intestines have been cleansed, they are put through a series of other processes, one of which is another cleansing operation in processing tanks.

The tanks are 34 ft long and hold 200 gal of liquid (a combination of chemical and water) in six compartments. The liquid temperature must be constant, to attain the desired washing and processing action.

To accomplish this, an electric heater on each tank, activated by thermostats within the tank, heats the liquid as it is circulated at 25 gpm through a heat exchanger. The long strands of intestines lie dormant in these tanks for a determined period of time.

The tanks are emptied and cleaned daily, and are individually filled each morning with a hose. When the liquid being used to fill the tanks was not at the proper temperature, there was too much delay before the individual heaters on the tank could bring the temperature up, or the room temperature could bring it down.

By installing a thermostatic control, the liquid temperature was automatically prevented from varying more than 1 F. This eliminated the delay, and has resulted in more efficient production. ±



DUCTWORK APPLIED to previously modernized ceiling makes neat installation without requiring dropped ceiling. Ducts are furred in, blend well with concrete structural beams at ceiling

Air Cooled Office

BY MURRAY KABILI
Vice President-Engineering
Typhoon Air Conditioning Co.
Div. of Hupp Corp.

To remain competitive with suburban air conditioned rental office space, downtown Milwaukee's 33-year-old Century Bldg. installed air conditioning as the big selling point in its remodeling program. After weighing the applicability of various types of systems against the building's structural design, the answer was found in a series of individual applications, each centered on 7½ to 10 ton air cooled, self-contained units.

BUILDING OWNERS traditionally have had three options in modernizing office space by adding air conditioning. Choices of equipment have generally been limited to central systems, multiple window units, and package units.

In recent years, however, a fourth system has evolved — an air cooled, self-contained refrigeration unit. One of the best applications of this type of air conditioning is installed in the Century Bldg. in Milwaukee.

Prior to installation, the building owner faced a typical situation: Built in 1926, the sturdy but aging structure had little immediate threat of competition. But constant improvement of the building was essential. While new construction in downtown Milwaukee has been virtually nonexistent, there has been some development of suburban areas and conversion of outlying city buildings into desirable office space. Air conditioning, of course, is a major appeal of these newer buildings.

Remodeling the Century Bldg. was the obvious counter-measure. Space could be easily tailored to custom requirements without major structural changes. But the very strengths of the building's excellent construction complicated the design and installation of air conditioning equipment.

Broad exposures in all four directions complicated temperature zoning in the L-shaped building, requiring

Self-Contained Units Simplify Building's Modernization

extensive controls to avoid overcooling the north side and to cope with varying loads on the east and west exposures, while controlling the maximum south wall heat load. Further, drilling holes to run chilled water lines from the basement to the eighth floor through thick masses of concrete could be quite expensive.

Window units offered advantages, but raised the problems of condensate disposal and damage to the esthetics of the building's facade. Also, additions to the electrical distribution system would be required.

And the owner had another problem: Milwaukee, though next to one of the world's largest water supplies, Lake Michigan, has a shortage of pumping capacity. This appeared to rule out the use of decentralized package units, even if the building's water lines were capable of supplying the quantities required on the hottest days. Too, a sudden pressure drop could shut down the air conditioning when it was most needed.

Milwaukee's climate is generally temperate, with comparatively few hot days each year. But these hot spells can come early (in May last year) or late (September and October in 1958), so the equipment must be ready to operate at a moment's notice, yet not be susceptible to sudden freezes.

Further, the modernization program must of necessity be done in stages and at low cost. Tenant leases expired at various times; some didn't want air conditioning and the decisions of others would be based on the extent of the rent increase necessary to amortize the new equipment.

Various solutions were explored. The answer was found in a series of individual applications, each centered on 7½ to 10 ton air cooled units.

Three different applications were dictated by special problems. On the stepped-back second floor, the evaporator and blower are mounted in a single cabinet suspended from the 12 ft ceiling of a storage room. The compressor and air cooled condensing unit are located a short distance away, on the roof of the first floor.

By ceiling mounting, valuable floor space for storage has been freed and the run between the evaporator and distribution ducts shortened. Ducts are installed above a dropped ceiling incorporating recessed lighting and acoustical treatment.

An entirely different approach was used on the seventh and eighth floors. Here, six 7½ and 10 ton units are free standing, three on each floor, (dividing each floor into three zones).

Full cabinet enclosure of the units makes possible installation of some of the equipment in visible areas. Others are in closets. Styling blends with office equipment, so esthetics are no problem. Top discharge ductwork has been painted to blend inconspicuously into office decor.

Both the seventh and eighth floor installations combine an evaporator, compressor, and blower in a single cabinet. The condensing units are mounted on the eighth floor roof. The vertical rise of refrigerant piping thus is more than 20 ft, in the case of seventh floor units, but does not adversely affect performance of the air conditioners.

Duct installations on these two floors differ from that on the second floor in that air conditioning was added after an acoustical ceiling and suspended fluorescent lighting had been installed. Ductwork therefore was laid up against the ceiling and furred in and painted. The duct layout is designed to blend in with the grid of structural beams along the ceiling.

Furring might be considered an unnecessary expense. However, it was deemed well worth the cost in preserving an uncluttered appearance.

The third area to be air conditioned was the sixth floor. Here, runs were too long to either the eighth floor roof or the first floor deck for most efficient operation. Installation was further complicated because there was no storage closet in which to conceal all required components.

As a solution, a 10 ton unit was placed near a window in an alcove converted into an equipment room. Only 20 sq ft of floor space was required.

Grilles set into the window exhaust warm air from the condenser and admit cool air. The equipment is housed in a room formed by dropping a deep soffit, containing the warm air return, and enclosing the area with three cut-down birch doors. The doors can be slid from place easily to give access to the unit. Air distribution ducts are covered by a false ceiling. ⧺

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

It's Risky Business to Depart from Specs

MANY TIMES a contractor does not perform his end of an agreement according to the letter of the contract. There are times when the contractor represents that his work will be to the satisfaction of the owner or a third party such as an architect.

What happens when the contractor's performance is substantial but not complete in some regard, or where the owner or an architect arbitrarily decides that the work is unsatisfactory and payment is withheld?

Here is how one court decided the issues involved:

Justabout, Inc. contracted with the I. M. Rite Apartments, Inc. to install a complete heating and air conditioning system in a new building. The contract price was $32,000. Among other terms, it was provided that the work would be performed according to exact specifications and to the satisfaction of both I. M. Rite and the building architect.

Through the course of the work Justabout received $15,000 on account. But upon completion of the plant I. M. Rite refused further payment.

"The work is not to my satisfaction," said Rite, "in that it is defective and not done according to specifications."

Justabout sued I. M. Rite and Rite filed a counter-claim for damages arising out of defective workmanship in the amount of $20,000.

The lower court found that I. M. Rite had dismissed the architect before the building was completed so that Justabout was unable to obtain his satisfaction. It further found that in some respects Justabout had not performed according to specifications and that there were some defects in workmanship.

The court determined that the defects damaged I. M. Rite to the extent of $2000, deducted that amount from the balance due Justabout, and rendered judgment in the amount of $15,000 in favor of Justabout.

Rite appealed the case to a higher court, arguing that, since Justabout had not performed according to the terms of the contract, it was not entitled to a judgment.

"Further," said Rite, "the contract stated the work would be done to my satisfaction. It was not and, therefore, Justabout is entitled to nothing."

The higher court stated the general rule of law to be that, where a person agrees to do a thing for another for a certain sum of money to be paid on full performance, he is not entitled to payment until he has done the thing as agreed. He is not generally entitled to any payment for only part performance.

"However," said the court, "this rule has been greatly relaxed in modern times. It is now a question of whether the work has been substantially performed in good faith."

The court held that, although Justabout had departed from the terms of the contract, the departures did not affect the usefulness of the heating or air conditioning plants. It found that the defects were slight compared to the magnitude of the work as a whole and that the $2000 deduction allowed I. M. Rite was a satisfactory compensation for the defects.

"Your complete dissatisfaction with the work of Justabout," the court told Rite, "is not the dissatisfaction of a reasonable man. A stipulation in a contract to perform to the satisfaction of one of the parties only calls for performance as should be satisfactory to a reasonable person."

The higher court affirmed the lower court's judgment.

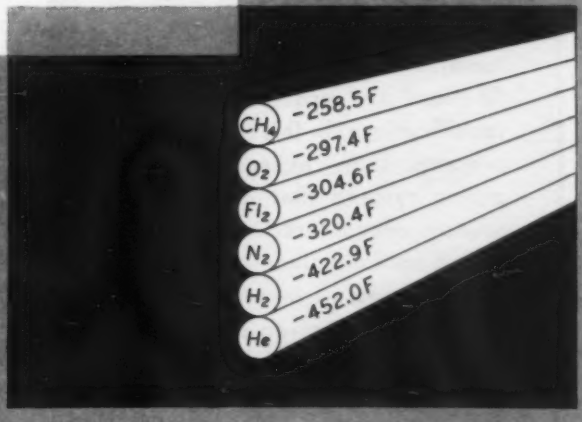
The difficulty that the courts find in cases of this sort is drawing the line between what is substantial performance and what is not. There is no accurate rule of thumb and any contractor who departs from specifications does so at a risk. ≠

HPAC ENGINEERING DATA FILE

Cryogenic Piping System Design Considerations

Piping systems for liquefied gases are similar in many respects to other piping systems. Differences that must be considered in design, fabrication, and operation are related to the low temperature of the liquids handled.

By Robert B. Jacobs



What to Consider When Designing Cryogenic Piping Systems

ALTHOUGH liquefied gases have been transported through piping systems for many years, a significant number of the people associated with the design, fabrication, and operation of piping systems have not been called upon to undertake problems in this area. A reason for this was that the suppliers of the liquids, which were primarily the components of air, could easily handle the task. Even though the use of liquefied gases had been steadily increasing for some time, it was only after the tremendous demand for these liquids as propellants for rockets that the need for a large number of designers, fabricators, and operators materialized.

As all liquids can be vaporized and may therefore be considered as liquefied gases, it would be well to specify the substances in which our interest lies. Perhaps the warmest liquid which the cryogenic engineer handles in large quantity is methane (natural gas), with a normal boiling point of −258.5 F; the interest in liquid methane is due to the desirability of transporting natural gas as a liquid. Proceeding down the temperature scale, we come to liquid oxygen whose normal boiling point is −297.4 F. Besides its great use as an oxidant in rocket engines, large quantities of oxygen used in industry are transported and stored in liquid form. Fluorine, with a normal boiling point of −304.6 F, is not in wide use at present, but a great deal of development work is being done in an effort to use it as an oxidant in rocket engines. Because of its exceptional reactivity, the corrosion and safety problems associated with the handling of fluorine are most challenging. The present techniques for handling liquid fluorine are unique because, in order to assure that no fluorine is discharged into the atmosphere, the fluorine is subcooled with liquid nitrogen. An appreciable amount of liquid nitrogen, which has a normal boiling point of −320.4 F, is used as a refrigerant and as a source for high pres-

Piping systems for transporting liquefied gases are not basically different from those for the more familiar fluids. But, some differences must be considered by the designer because of the temperature range encountered — room temperature down almost to absolute zero or −459.6 F. These differences are due to differences in the properties of materials at low temperatures, differences in emphasis in specifications and orders of magnitude of specifications. In this report, the author presents some aspects of cryogenic piping systems that differ from those usually encountered. The topics presented herein include properties of materials, and insulation techniques. Others will be given in a future issue.

The author is chief of the Cryogenic Equipment Section, National Bureau of Standards, Boulder, Colorado. He was awarded a PhD in applied science at Harvard University, and an MS in mechanical engineering at the Massachusetts Institute of Technology following undergraduate study in mechanical engineering at the University of California. Dr. Jacobs has been concerned with problems of handling, storage, and transportation of liquefied gases since beginning at the National Bureau of Standards in 1951. His work includes research on two-phase fluid flow, pumping and cavitation, boiling heat transfer, flow measurement, pressurization and stratification, insulation, and equipment optimization.

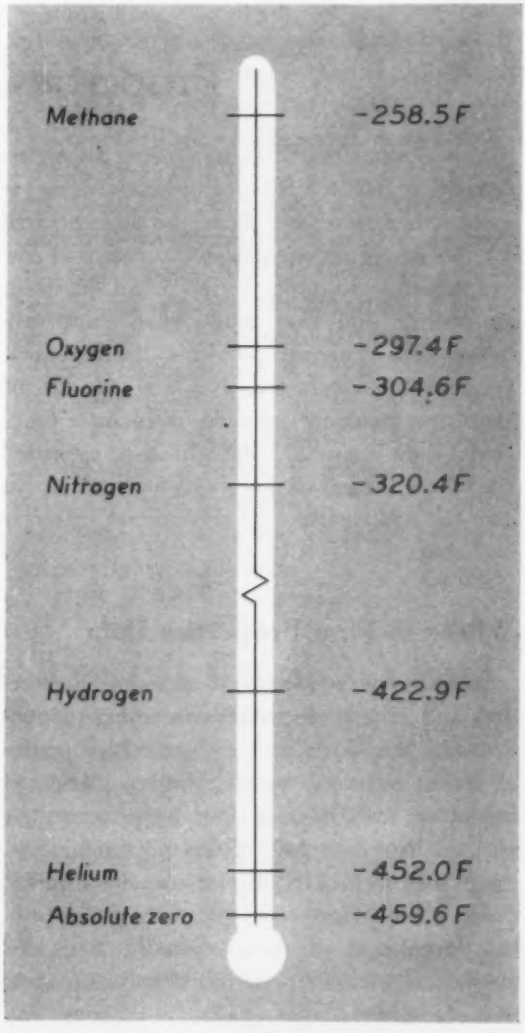
sure gas; one of its primary attributes is its inertness, and consequent safety. The advantages inherent in the use of liquid hydrogen as a propellant for both chemical and nuclear rockets lead to a high probability that the piping system engineer will be concerned with this fluid at −422.9 F. And finally, even though helium is not used on a large scale as a liquid, it will be transported as a liquid; thus, the engineer who is concerned with this fluid will deal with temperatures down to −452.0 F.

It is therefore apparent that piping systems for liquefied gases will encounter temperatures very near absolute zero (−459.6 F). However, as the systems are fabricated at room temperatures, and may be subjected to working loads at room temperature as well as at operating temperatures, the piping system engineer, who is concerned with liquefied gases, will be concerned with the whole temperature range from near absolute zero to atmospheric temperature.

If this article were to have a keynote, it would be that piping systems for liquefied gases are not basically different from those for the more familiar fluids. The apparent differences stem from differences in properties of materials due to the different temperature range, differences in emphasis in specifications, and different orders of magnitude of specifications.

Properties of both the structural materials used in the piping systems and the fluids flowing therein must be known to permit design computations to be made. Therefore, data applicable to the desired temperature range, or adequate extrapolation formulae, are a necessity. An engineer concerned with valve design may notice that, whereas the emphasis for normal temperature design might be on hydraulic efficiency and leak tightness across the seat and through the stem packing, the emphasis for cryogenic applications might be concerned with differential contraction, freezing of packing material, icing of movable parts, seat materials with satisfactory room and low temperature properties, or insulation. An example of a specification which may have a different order of magnitude in cryogenic applications than in ordinary practice is permissible heat leak. Insulations with mean effective thermal conductivities of less than 0.0002 Btu per hr per ft per F are common in cryogenic equipment while for the same temperature range, one of the best conventional insulations has a mean thermal conductivity of about 0.02 Btu per hr per ft per F.

In addition to the mechanical properties commonly used in the design of equipment, cryogenic equipment requires a particular awareness of thermal expansion coefficients and specific heats. A knowledge of the former is required so that, after equipment is cooled to its operating temperature, the required clearances are attained and thermal stress limitations are obeyed. For example, a 1 in. OD polymonochlorotrifluoro-



NORMAL BOILING POINTS of common cryogenic liquids indicate minimum temperatures that must be considered in piping system design

ethylene O-ring, which seals stainless steel flanges at its outer diameter at room temperature, would have a diametral clearance of approximately 0.007 inch at liquid hydrogen temperature. A copper liquid hydrogen piping system 100 feet long would contract about 4 inches during cooldown.

Specific heat data are required for prediction of cooldown characteristics of equipment. Thermal conductivity is another property which the cryogenic designer should bear in mind. If heat leak through metallic members is to be minimized, a stainless steel, monel, or other poorly conducting alloy should be used. If temperature stratification in liquid containers is desirable, the inner tanks should be stainless steel. If stratification is to be inhibited, aluminum or copper alloys may be desirable.

The purpose of this article is to present those aspects of piping systems for liquefied gases which differ from the usual considerations. Items such as conventional strength calculations or commonly used hydraulic considerations will not be discussed. Techniques such as shielded arc welding, silver brazing, high vacuum technology, which should be familiar to the designer, fabricator, and operator will not be discussed. However, areas such as properties of materials, insulation techniques, fluid mechanics, pumping, and instrumentation, in which unique information, data, or techniques are encountered will be treated.

Properties of Materials

It is obvious that data concerning all of the properties required for equipment design at room temperature and above are also required for the design of equipment to operate at low temperatures. In order to make all pertinent information and data available to those concerned with cryogenic problems, the Cryogenic Engineering Laboratory, National Bureau of Standards, Boulder, Colorado maintains a Cryogenic Data Center. Although it is estimated that the Center will not be completely up to date for another year, its services are currently available.

Where to Find Properties Data

A series of articles by Corruccini[1] presents data and general discussion concerning thermodynamic, transport, and mechanical properties of solids, including metals, plastics, glass, and insulating materials, at low temperatures. A selected list of useful references pertaining to the properties is given in part one of the series. Chelton and Mann[2] have assembled a very useful compilation of thermodynamic, transport, mechanical, electrical, and miscellaneous properties of solids, liquids, gases, insulations, etc. Outside of References 1 and 2 and the Data Center, useful collections of cryogenic data apparently exist only in the private files of those who have been working in the field.

Mechanical Properties of Solids

A rather complete bibliography of references on mechanical properties of solids below 32 F has been assembled by Kropschot and McColm.[3] This report covers the literature from 1945 to 1955, and includes an abstract for each reference. As with other materials, the tensile strength of austenitic stainless steels, copper alloys and aluminum alloys increases greatly with decreasing temperature; furthermore, even at liquid hydrogen temperature these specific materials retain sufficient ductility to permit their use under essentially the same impact and vibration specifications as at normal temperatures (most other common structural materials suffer a loss of ductility at low temperatures). It follows that equipment fabricated of these materials, which is to be operated at all temperatures from room temperature down, should be designed using room temperature strength data. It is also apparent that if weight and space specifications are not severe, equipment for use at low temperatures only can be conservatively designed

[1]*Numerals refer to references listed on page* 140.

by utilizing room temperature data. If weight limitations are severe and equipment is to be subjected to working stresses only after cool-down, appreciable weight saving can be realized by designing to the mechanical strength available at the operating temperatures. Because of the wide use of welding in cryogenic equipment, information concerning the mechanical properties of weldments at low temperatures is required by the designer. Unfortunately, work in this area is very limited (see Reference 4).

Plastics Suited for Certain Parts

Because of their light weight, low thermal conductivity and adequate mechanical properties, plastics have found wide use in cryogenic equipment as insulating supports, gasketing material, valve seats, insulation, tank material, etc. However, adequate information is not available for optimum design in this area; a few results have been reported by Reed and Mikesell[8], McClintock[6], and Corruccini[1]. Epoxy resins have been successfully used as structural adhesives in cryogenic equipment for use at temperatures down to −423.6 F. McClintock and Hiza[7] have reported work in this area.

Information pertaining to the electrical and magnetic properties of solids at low temperatures is meager, and consequently optimal design of electric and magnetic equipment to operate at these temperatures is difficult. As most measurements are made with the purpose of investigating basic behavior, materials which are not of interest to the designer are often studied. Examples of the type of work which is directly useful to the engineer are afforded by Hall[8], et al, and by Brown and Brennand[9].

Properties of Cryogenic Fluids

Although there is still much to be desired in connection with the properties of fluids, especially in the high pressure liquid and the high density gas regions, sufficient information is available to produce satisfactory, but not optimum designs. Knowledge of most thermodynamic (pressure, density, temperature, specific heat, etc) and transport (viscosity, thermal conductivity, etc) properties is necessary for the desired fluid flow, heat transfer, pumping, and other calculations which must be made by the piping system engineer. Although the effort is apparently not yet intensive enough, programs to determine some of the necessary information are now underway. The paper of Woolley, Scott, and Brickwedde[10] is probably still the best compilation of the properties of hydrogen. Although comparable compendia for the other liquefied gases do not exist, it is the intention of the Cryogenic Data Center, referred to above, to issue such documents as soon as possible. As there is insufficient space here to list even a token sample of the references pertinent to fluid properties, the reader is advised to obtain necessary information from Reference 2, from the Cryogenic Data Center, or directly from the various abstracting journals.

How the Systems Are Insulated

The effectiveness of insulations required for piping systems for liquefied gases runs the gamut from no insulation to the best vacuum-type insulation. The type of insulation used for a particular application is determined by the same considerations employed with more common systems: allowable heat leak, material and installation costs, operating and maintenance costs, ruggedness, length and frequency of use, vapor (air, as well as water will condense on piping when operating temperatures are below that of liquid air) barrier problems, etc.

There are many reasons why it may be desirable to use insulation; more obvious ones are to prevent the loss of liquid, to prevent cooling of adjacent equipment, and to minimize pressure drops by preventing two-phase (liquid-vapor) flow. On the other hand, one can justify, and recommend, that no insulation be used when flow rates are relatively high, systems are relatively short, and use times are relatively short. It should be borne in mind that in many applica-

"For cryogenic piping systems of any permanence, there seems to be no economic justification for not using insulation."

tions a piping system will not have time to reach steady state, and so the transient characteristics of insulations, not the steady state properties, will be the important design criteria.

When Are Systems Not Insulated?

The greatest, and perhaps only widespread, use of uninsulated piping systems for liquefied gases is currently at rocket engine test sites. The storage tanks are usually well insulated but the transfer systems are not; consequently, as much as 75 percent of the liquid oxygen purchased by a test site may be lost. For transfer systems of any permanence, there seems to be no economic justification for not using insulation; in many cases, high vacuum insulation can be justified.[11] Good reasons for leaving heavy run tanks uninsulated at rocket engine test sites may exist, but the author is not aware of them. On the other hand, as the loss of liquefied gas due to heat leak is a function of heat leak per unit mass of fluid flowing,[12] transfer systems with high flow rates can tolerate poor insulation. Furthermore, when a transfer operation is of short duration, as in some high-capacity propellant loading systems, the system should be uninsulated since the loading operation would be complete before an insulation could become effective.

The advisability of using insulation aboard a vehicle where weight and space limitations are severe, may be determined primarily by these limitations. It is probable that in-flight insulation of liquid oxygen piping systems in present missions is not justifiable, except in situations where piping passes through fuel tanks, etc. The preceding comments apply to liquid nitrogen as well as liquid oxygen, except that, as shall be seen, the condensing of oxygen enriched air on liquid nitrogen equipment alters the heat transfer calculations.

The use of uninsulated piping systems with liquid hydrogen is not such a clear-cut issue. It is probable that for very rapid loading, uninsulated systems can be used; however, it will be necessary for current investigations to proceed further before reliable design information applicable to uninsulated hydrogen systems will be available. Except when liquid helium is to be purposely vaporized and heated for the production of gas, there are apparently no anticipated applications in which uninsulated piping systems will be used with this fluid.

Heat Transfer to Uninsulated Piping

The factors determining both the steady and transient heat transfer rates to liquefied gases in uninsulated piping systems depend upon the liquid as well as upon ambient conditions. If the static pressure of the fluid is above its local vapor pressure, single phase flow will probably exist, and the conventional concepts and methods of forced and free convection apply. However, if boiling occurs, the heat transfer to the resultant two-phase fluid cannot be readily calculated. There are data available for pool boiling,[13] but some of it is inconsistent; the data applicable to flow systems,[14] is inadequate, but further investigations are currently being made. It should be borne in mind that in some uninsulated equipment, the factors controlling heat transfer rate are on the outside surfaces, and so the lack of boiling data will not be a hindrance to making adequate heat transfer calculations.

Inasmuch as the liquefied gas essentially determines the temperature of the outside surfaces of uninsulated equipment, and this temperature, along with atmospheric conditions, determines the phenomena which occur there, the influence of the atmosphere on heat tranfer to uninsulated equipment depends upon the liquefied gas flowing. A loose frost, or snow, which can halve the heat transfer rate,[15] normally forms on liquid oxygen equipment; however, as this condensate

is easily blown off, it does not provide reliable insulation. Some people report that rain bounces off of uninsulated liquid oxygen containers while others report that the rain adheres, building up thick layers of ice. It is apparent that controlled investigation of these problems should be undertaken. Condensation phenomena on liquid oxygen equipment is not straightforward because the condensable component (water) is but a small and variable part of the surrounding medium.

Air Condenses on Piping Too

Air, as well as water, condenses on the surfaces of uninsulated liquid nitrogen equipment. Because the normal boiling point of liquid nitrogen is below the liquefaction temperature, but above the freezing point of air, liquid air continuously runs off of uninsulated liquid nitrogen equipment, washing the ice off with it. Consequently, the outside film coefficient, which may be the rate determining factor, should be computed from condensing information. This type information can be found in any of the several good texts (e.g. Jakob[16]) on heat transfer, but may not be directly applicable because of the complex nature of the condensate. The transient condensation problem with saturated vapor has recently been discussed by Sparrow[17]. This treatment may be of value in situations where the transient is an appreciable fraction of the operation and where temperatures are low enough for air to condense.

Because the normal boiling point of fluorine (−304.6 F) is below the condensing temperature of air, air will condense on fluorine equipment, and heat transfer computations should also utilize condensation concepts. However, as the fluorine will probably be refrigerated with liquid nitrogen, the heat transfer to the fluorine will be negligible and negative. The heat transfer to the refrigerant can be handled as discussed above.

Experience with uninsulated liquid hydrogen piping systems has shown that solid air does not adhere to the exposed surfaces, but is continuously washed off by liquid air. Therefore, heat transfer computations for this fluid also should involve condensation considerations. Richards[18] has shown that heat transfer to hydrogen in uninsulated piping systems depends primarily upon the external condensate film, and that conventional correlations do not predict the measured heat transfer rates.

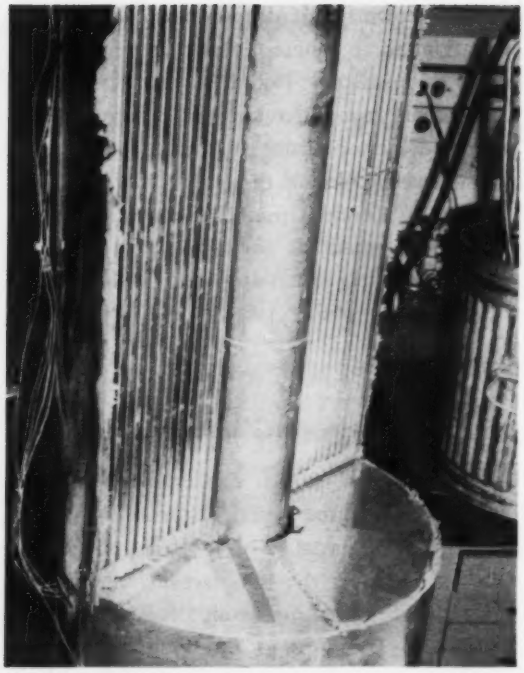
Use of Conventional Insulations

Whether or not insulation, and especially non-vacuum type insulation, is used depends to a great extent upon the length of time that equipment is in use at low temperature during each operation. It is obvious that if the time is short, the equipment will not have time to cool down, much less transfer energy from the environment. Also, even if complete cooldown of metallic parts does occur, the thermal diffusivities of conventional insulations (e.g. glass fiber) are usually small enough so that a fraction of an inch of insulation thickness is adequate. For example, a 1-13/16 in. thickness of glass fiber insulation with a vapor barrier on a 4 in. liquid oxygen line does not reach steady state for almost 2 hr.[19] However, the use of conventional insulations, with liquid oxygen pipe lines for example, can reduce the steady state heat leak by 96 percent.[15]

Vapor Barrier is Important

The primary problem associated with the use of conventional insulations stems from the requirement of a vapor barrier. This problem is automatically circumvented with vacuum insulations. The objective is, of course, to prevent water, air, etc. from condensing in the insulation, thereby materially decreasing the quality of the insulation. Either the condensate can solidify and produce a layer with the relatively high thermal conductivity of the solid, or it can liquefy, flow to warmer parts of the insulation and evaporate, causing a high-rate, regenerative-type heat transfer mechanism. There are plastic and glass foam-type insulations which have unicellular structure and which can be preformed. With these it is only necessary to seal along the joints with a suitable mastic. Programs to develop satisfactory "foamed-in-place" plastic insula-

CONCENTRIC ALUMINUM SHELL insulation under test here is prefabricated into semicylindrical sections



SHELLS shown exposed here act as radiation shields and are spaced to reduce convective heat transfer

tions (e.g. the polyisocyanates) are underway. These insulations will have no joints requiring sealing; however, there is still difficulty with failure due to thermal stress. Concentric aluminum shell insulation, which is commercially available, should be mentioned. Although its insulating quality is about the same as rigid cellular glass insulation and not as good as fiber material,[15] it is quite popular. The shells act as radiation shields and are spaced so as to effectively reduce convective heat transfer. This type of insulation is prefabricated into semicylindrical sections which are easily installed and effectively sealed with a puttylike mastic.

Three Types of Vapor Barriers Used

With open, or porous, insulations a covering sheath is generally used to provide a vapor barrier. Depending upon the insulation and the ruggedness required, the sheath can be flexible and relatively fragile, or it can be a strong metallic covering. In providing a vapor barrier with the necessary ruggedness, the designer may end up with equipment that is more expensive and heavier than, but not as good as, vacuum insulated equipment. The covering sheath is generally designed on the basis of one of three ideas:

1) It can be gas tight. Because the pressure inside of the insulation space will drop when the equipment is cooled, this type of installation must either be able to withstand external pressure after cooldown or be able to withstand internal pressure before (and perhaps after) cooldown.

2) The covering can be relatively gas tight but will be allowed to "breathe" a gas that does not condense at operating temperature. This system eliminates the need for the sheath to withstand significant pressure differences.

3) The covering need not be gas tight, but a sufficient quantity of suitable gas is fed into the insulation so that a positive gage pressure is maintained therein; consequently, air will not flow into the insulation.

The second method is generally the most desirable. The type of vapor barrier used depends also upon the insulation. It is obvious, for example, that rigid insulations, such as cork or glass foam, supply sufficient structural strength to prevent a very flimsy covering sheath from collapsing under external pressure.

Finally, besides the difficulty experienced in completely sealing a vapor barrier, especially around valve bodies, supports, etc., there is the problem of ruggedness with respect to abuse by both personnel and the environment. An accurate evaluation of this factor is necessary if continual maintenance problems are to be avoided on the one hand, and if the cost of the conventional insulation is not to become exorbitant on the other.

The thermal design of piping systems for liquefied gases using conventional insulations involves conventional conductive and convective heat transfer calculations. Valid values of the pertinent properties at the appropriate temperatures must be used.[15,19,20,21,22] Determination of the transient characteristics requires knowledge of specific heat, density, and thermal conductivity while determination of steady-state characteristics requires a knowledge of thermal conductivity only. In addition to the insulation characteristics, calculations involving convection and radiation between the environment and the outside of the insulation will be required for the less effectively insulated systems. However, as the thermal resistance of insulation is much greater than that offered by the fluid in the piping system, the pipe is very close to fluid temperature and heat transfer mechanisms occurring within the piping system can usually be ignored.

Vacuum Insulations Most Effective

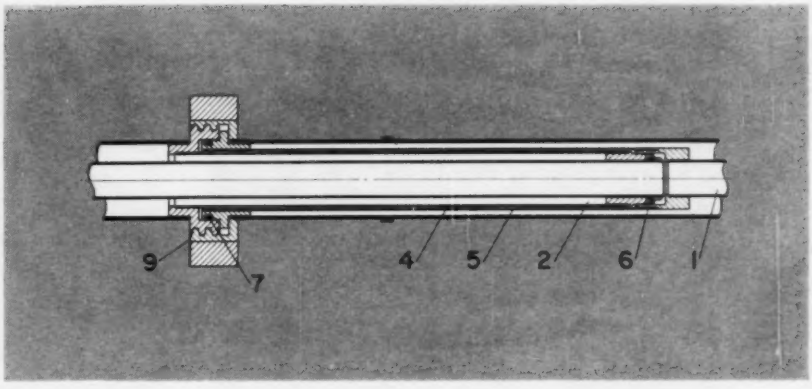
Although vacuum-type insulations have been used for many years to insulate tanks, there has been a strong reaction against their use with piping systems and other components. The main reason is the almost universal lack of knowledge and technique concerning high vacuum systems; the situation does, however, seem to be changing. Once the suspicion of unreliability had been overcome and enough fabrication experience had been obtained so that realistic cost estimates could be made, it was possible to demonstrate that, in many cases, vacuum insulated piping systems were economically, as well as technically, desirable.[11] With the use of liquid hydrogen as a propellant, and with the increased handling of helium in liquid form,[23,24] the place of vacuum-type insulations in piping systems for liquefied gases cannot be denied.

Vacuum-type insulations can be divided into three classes: high-vacuum, evacuated powder, and so-called "superinsulations." If we note that the energy transport through vacuum-type insulations is effected by radiation, gas conduction, and conduction through solids which may be in the insulation space, the various classes of insulation are readily discussed.

In high vacuum insulation, gas conduction is made negligible by having a sufficiently low pressure, normally in the neighborhood of 10^{-6} mm Hg. The attainment of these pressures requires the use of both mechanical vacuum pumps and diffusion pumps. In some cases, advantage can be taken of the condensation and adsorption of residual gases on the cold surfaces to assist in achieving the required vacuum. Van Gundy[25] has reported research on condensing vacuum insulations for cryogenic equipment. The vacuum space in these insulations is filled with a gas (e. g. carbon dioxide) which has a very low vapor pressure at the operating temperature of the equipment. When the equipment is put into operation, the gas condenses to a solid on the cold surface, producing an excellent insulating vacuum. For some equipment using this scheme, no vacuum pumps are necessary. For the rest, only rough mechanical pumps are required in order to purge the system. With liquid hydrogen and helium equipment, air can be the condensing gas if an adsorber is attached to the cold surface to adsorb the hydrogen naturally present in air.[26] In addition to the advantage encountered with the minimal pumping system requirement, there are two other advantages to condensing high-vacuum insulation:

1) A small leak that would ruin the static high vacuum in a piece of equipment during storage would not ruin the usability of the equipment if condensing vacuum were used. The reason is that air would leak into a static vacuum continuously, while it would leak into a condensing vacuum only when the equipment is in use.

2) In systems fabricated with commercial metals the vacuum deteriorates because hydrogen outgases from the metal parts. With static



DISMOUNTABLE VACUUM INSULATED transfer piping is shown here. Numbered components are: 1) liquefied gas, 2) vacuum space, 3) flexible section to permit differential contraction, 4) male (or bayonet) part of coupling, 5) female part of coupling, 6) seal to restrict flow of liquid between parts 4 and 5, 7) room temperature O-ring to seal coupling, 8) vacuum seal-off valve, 9) coupling, and 10) spacers or supports

vacua, adsorbers must be installed to adsorb this gas. In condensing systems using carbon dioxide, however, the hydrogen is adsorbed by the carbon dioxide.

High Vacuum Insulation Heat Leak

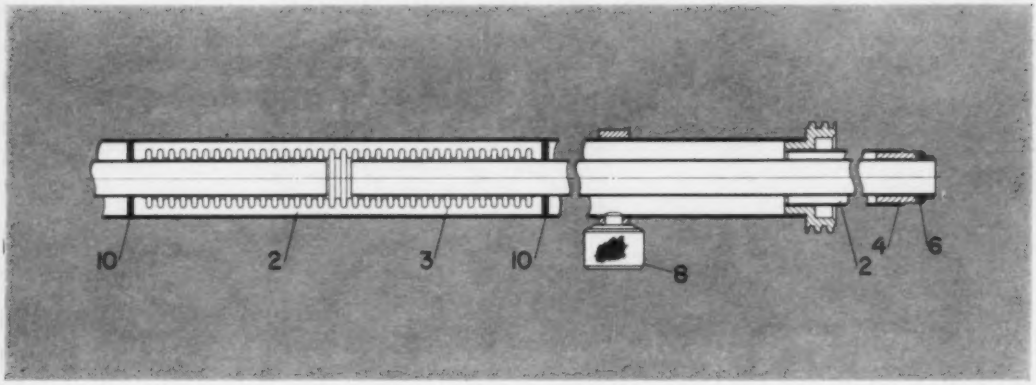
Ideally there is no heat transfer by conduction through solids in high vacuum insulation. In reality however, some occurs through the support structures and spacers required to suspend the low temperature regions within the vacua and some through instrumentation lines and leads, and piping that must traverse the vacuum space from the ambient to the low temperature regions. Support techniques with very low effective thermal conductivities have been developed through the ingenious use of plastics and multiple-contact structures.[27] The most common practice is to design the necessary metallic members, which contribute to heat leak, with lengths as long as are feasible and cross-sectional areas as small as are feasible.

The radiant energy transport, which is often the dominant mode in high vacuum insulation, is minimized by using surfaces of very low infrared emissivity for the walls that face the vacuum region.[12,28] It is important to note that surfaces which appear to have very low emissivity or high reflectivity with visible light, may have poor reflectivity in the infrared region where most of the energy of room temperature radiation is concentrated. Thus, visual appearance may not be a reliable criterion for determining the suitability of surfaces for use in high vacuum insulations. Also chemical, rather than mechanical, polishing is desirable because the latter work hardens the surfaces, thereby reducing the infrared reflectivity.

The common method for reducing heat transfer through high-vacuum insulations is the use of radiation shields. Ideal "floating" shields reduce the heat transfer to about $(n + 1)^{-1}$ times the unshielded value, where n is the number of shields. Many of the "superinsulations" are merely high vacuum insulations with ingenious radiation shielding which has an effectively large n in a relatively small space. High vacuum insulations for liquid hydrogen and liquid helium can reduce the energy transport to the liquid by 99.5 percent through the use of a nitrogen cooled radiation shield. Although the effectiveness of this insulation arrangement is very high, the additional bulk and weight, and the required availability of liquid nitrogen are drawbacks. In many applications where nitrogen cooled shields are being used, the "superinsulations" will be used in the future.

Evacuated Powder Insulations

Evacuated powder insulations have been used for many years for insulating both mobile and stationary tanks for the storage of liquefied gases. Their advantages over the non-shielded high vacuum type are that only rough vacua are required and, for larger equipment, the heat transfer is less. The vacuum space in this insulation is filled with a mineral powder which, if of a satisfactory material and adequate thickness,[12] acts as multiple radiation shielding and also reduces energy transport by gas conduction. Be-



cause of the latter effect, high vacuum is not required. As a pressure of 10^{-2} mm Hg or higher is adequate, only mechanical vacuum pumps are needed. The mechanism of solid heat conduction through the powder is present, however. In order to provide adequate radiation shielding and to reduce solid heat conduction to a tolerable value, these insulations must be relatively thick. The resultant increases of weight and bulk are major drawbacks for many applications. There is also some question of the desirability of using evacuated powder instead of high vacuum in piping systems because of increased fabrication costs and possible maintenance complications.

So-called "superinsulations" differ from the other vacuum-type insulations in two respects:

1) Their effective mean thermal conductivities are less than 1/10 those of the commonly used powders, making them more than 10 times as effective.

2) Details about some of them are not known because their developers consider them as proprietary. They are, however, vacuum-type insulations. Those whose details are known are high vacuum insulations with clever shielding arrangements which effectively provide a large number of radiation shields in a small space.

Heat Transfer Calculation Methods

The methods used for calculating heat transfer through vacuum-type insulations are straightforward. As radiant energy is usually the only significant mode of energy transport in high vacuum, only information concerning geometry and optical absorptivities is needed. [12,28] If, for some reason, the pressure in a high vacuum insulation becomes too high (greater than 10^{-6} mm Hg), the energy transport due to gas conduction should be computed.[29]

The energy transport through evacuated powders occurs by means of radiation, gas conduction, and solid conduction. The presence of the powder reduces the energy transport by radiation and gas conduction. Although the three mechanisms are currently being investigated separately, engineering design computations are based upon mean apparent thermal conductivities.[12] As these numbers are derived from the experiments by means of the Fourier conduction equation, conventional heat conduction calculations are used. The values used for the conductivities must, of course, apply to the temperature range in question. Values of apparent mean thermal conductivities have been reported by Fulk,[30] et al; however, more data are needed, especially down to liquid hydrogen and liquid helium temperatures. It should be noted that data reported as effective mean thermal conductivities have limited application because evacuated powders do not, in fact, obey the Fourier conduction law.

Available data regarding superinsulations are reported as mean effective thermal conductivities, and so the Fourier conduction law is used for the computation of heat transfer through these insulations. This method of presenting data also detracts from the usefulness of the information. As these insulations involve energy transport by solid conduction as well as by radiation, the best way to present data is not obvious.

In those cases where the solid conduction dominates, the currently used conductivity concept is probably acceptable. However, in the cases where the radiation is dominant, it may be more useful to report the data in terms of radiation concepts, e. g. effective number of floating radiation shields of a certain emissivity per unit thickness of insulation.

Good Vacuum Technique Needed

A final word about vacuum-type insulations concerns vacuum technique. The manufacturer and fabricator of high vacuum equipment must realize that the equipment must be absolutely clean, tight, and adequately outgassed. It is difficult for those without high vacuum experience to realize how important technique is; those who have the "know-how" have required years to develop their techniques. Absolutely tight joints can be made by means of shielded arc welding, silver solder, and soft solder techniques. The tightness is best tested with mass spectrometer leak detectors. Of course, if systems are going to be continuously pumped, they need not be absolutely tight, but this is not a healthy frame of mind. Finally, when the system is pumped it should be heated to as high a temperature as is feasible to assist in driving out as much of the adsorbed and dissolved gases as possible. If this is not done with equipment in which static vacua are to be used, the vacuum will deteriorate quite rapidly. In many cases, the vacuum will not improve during cooldown because hydrogen, which is present in many commercial metals, has diffused into the vacuum space.

[This discussion of the unusual aspects of cryogenic piping systems will be continued in a future issue, at which time the fluid-mechanical design, installation and operation, and safety considerations will be presented.]

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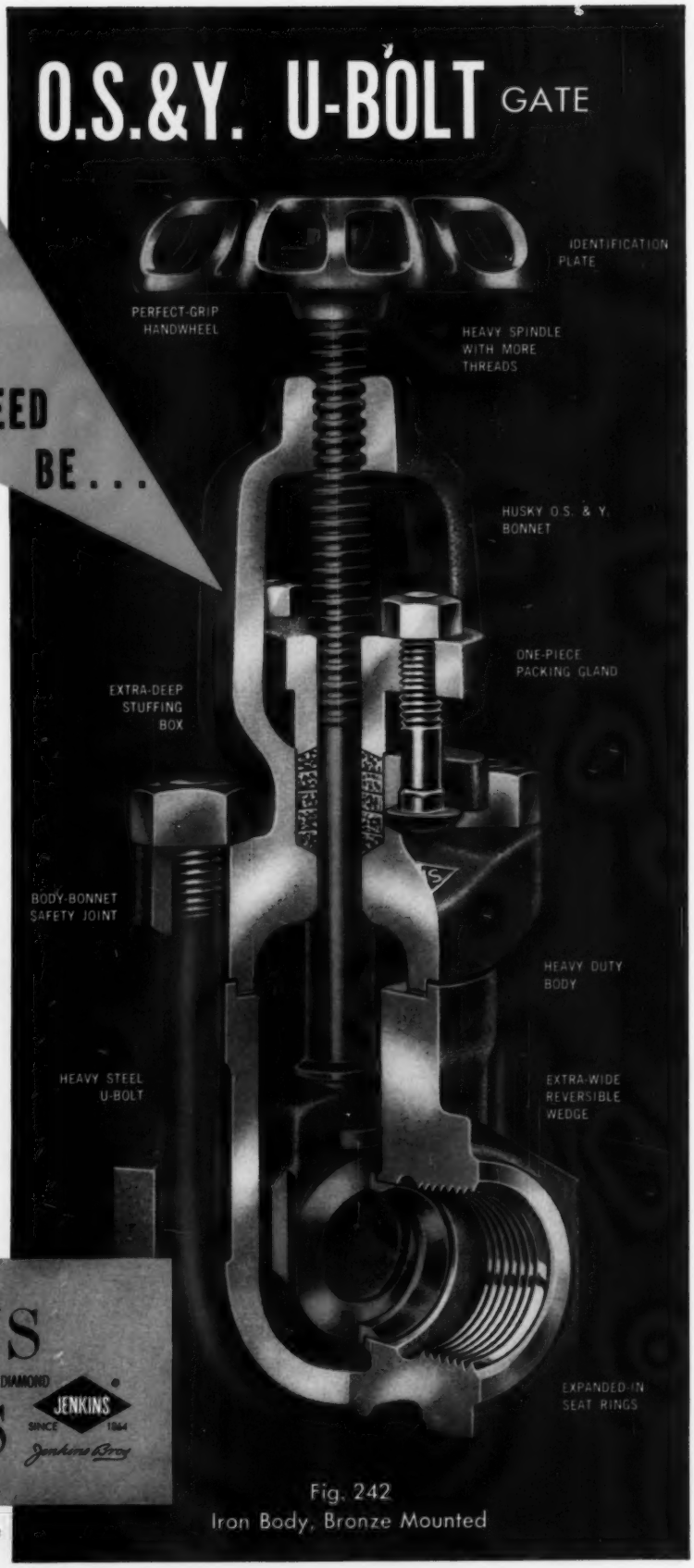

Fig. 242
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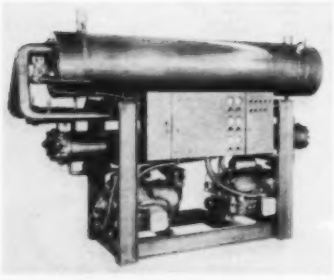

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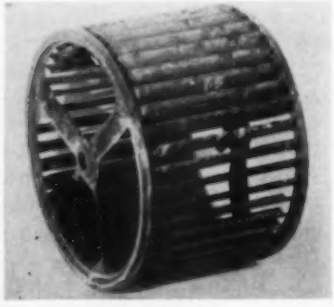

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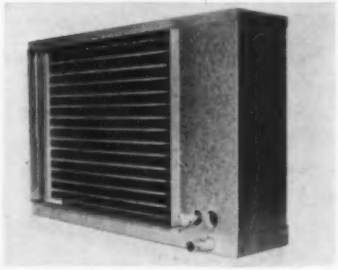

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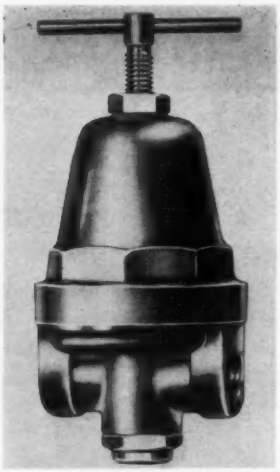

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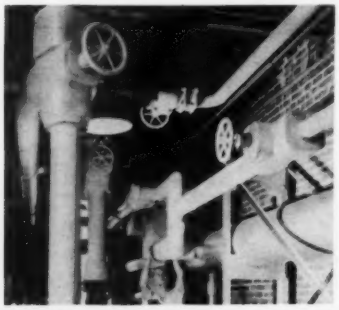
...recommended for air, oil, gases, (except steam) and all non-corrosive fluids — *A. W. Cash Valve Mfg. Corp., P. O. Box* 191, *Decatur, Ill.*

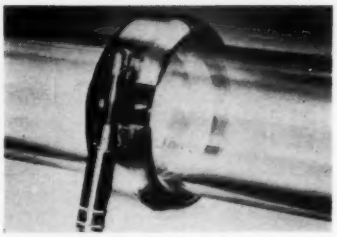
Valves feature outlet pressures that are not affected by wide variations in inlet pressures or variable rates of flow; spring ranges from 2 to 175 psi with maximum temperatures of 200 F; available in ¼, ⅜, ½ in. sizes; descriptive bulletin "1-17" available.



Pipe Insulation . . .

...which can be slid over pipes or slit and snapped over already installed pipes and sealed—*Armstrong Cork Co., West Liberty St., Lancaster, Pa.*

Insulation has built-in vapor barrier; nominal ¾ in. covering stops condensation at temperatures down to 0 F; may be used on lines operating up to 200 F; thermal conductivity of 0.28 at 75 F mean temperature allows use of minimum wall thickness on cold as well as heated lines.



Glass Drainline . . .

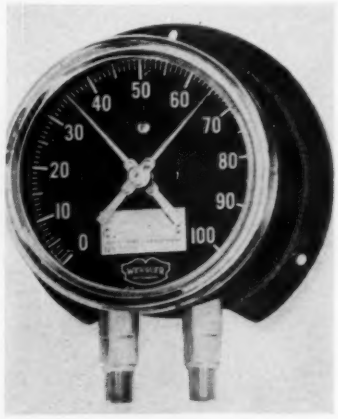
...featuring one-piece couplings for quick permanent compression joints —*Corning Glass Works, Corning, N.Y.*

System is designed for vertical or horizontal mounting and can be buried in ground; handles working pressures up to 15 psig and temperatures to 250 F; standard pipe lengths of 5 nd 10 ft are available with diam range from 1½ to 6 in.; descriptive bulletin "29-B-8" available on request.

Pipe Tracer . . .

...for locating and pinpointing pipe stoppages in non-metallic pipes—*The Goldak Co., Inc.*, 1544 *W. Glenoaks Blvd., Glendale* 1, *Calif.*

Consists of attaching radioactive source to wire, and pushing it down line; operator follows exact path of source on surface with instrument that indicates any obstruction.



Vacuum Gages . . .

...for suction and discharge of water circulating pumps—*Weksler Instruments Corp.*, 195 *E. Merrick Rd., Freeport, Long Island, N.Y.*

Features accuracy of 1.0 percent of scale; for steam, air, oil, gas, water, etc., from 30 in. Hg vacuum to 10,000 psi; 3½, 4½, 6, 8½ in. dials.

Vapor Barriers . . .

...with applications as insulation facings or lining of pipes and ducts — *American Sisalkraft Corp.*, 55 *Starkey Ave., Attleboro, Mass.*

Barriers consist of aluminum foil and kraft paper bonded together with flame extinguishing adhesive and reinforced with fibered glass strands; when temperature surrounding material reaches combustion stage, adhesive releases gases or vapors that prevent flame from spreading throughout material.

Submersible Pump . . .

...to remove air conditioning condensate in systems requiring continuous circulation of liquids—*Kenco Pump Div.*, 1305 *Oberlin Ave., Lorain, O.*

Pumping capacity rated at 3300 gph at 10 ft discharge head due to high torque output of 1/3 hp single-phase motor; designed with corrosion-resistant cast-bronze construction and liquid level control built into watertight top.

Liquid Level Control . . .

...for use in outdoor storage tanks where ice may result from low temperatures — *Magnetrol, Inc.*, 2110 *S. Marshall Blvd., Chicago* 23.

Control may be installed in tanks by means of bracket mounting; switch mounting is submersible; when water temperature reaches 35 F in water in aluminum tube around displacers, thermoswitch cuts in to supply current to immersion heater in tube; displacers are set to maintain constant 36 in. differential; maximum differential can be shortened in 6 in. increments between 36 in. maximum and 6 in. minimum.

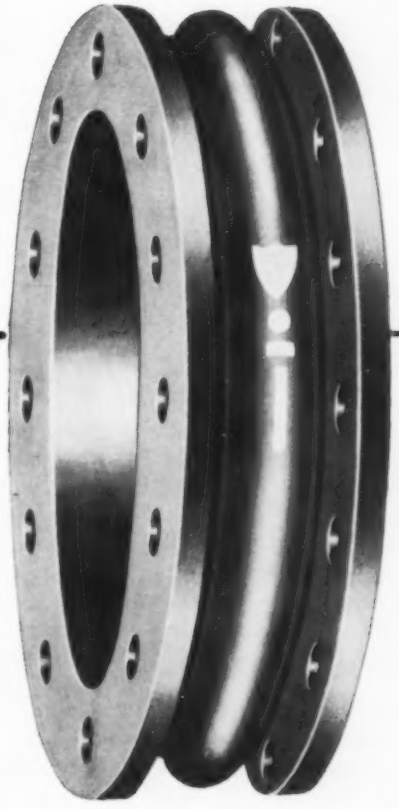
EXPANSION JOINTS

THEY STAY FLEXIBLE
when handling the most severe chemicals

"U.S." Expansion Joints of butyl rubber construction are recommended for handling certain chemicals.

Typical of these are:

ANILINE-R.T.
DIETHYL SEBACATE-R.T.
HYDROCHLORIC ACID (37%) UP TO 122° F
SODIUM HYDROXIDE (20-50%) UP TO 158° F
SODIUM HYPOCHLORITE (20%) UP TO 158° F
SULFURIC ACID (50%) AT R.T.



"U.S." Expansion Joints remain completely flexible at all times. Joints made of neoprene or natural rubber stiffen up, crack and fail when handling the above chemicals.

For the most severe service, specify "U.S." Expansion Joints lined with Teflon. These "U. S." Joints are ideal for handling most chemicals and solvents.

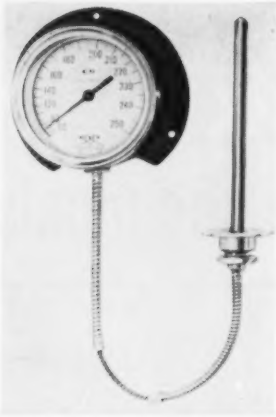
"U.S." Expansion Joints are in use in every kind of industry. Some of these joints have been on the job since 1924, the year "U.S." invented them! Long-lived, they *prolong the life* of equipment in pressure and vacuum systems.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery, and quality industrial rubber products.

Mechanical Goods Division
United States Rubber
WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS
Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

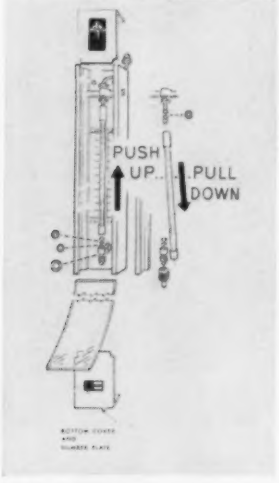
EQUIPMENT DEVELOPMENTS
Continued



Dial Thermometers . . .

. . .for duct installation—*Weksler Instruments Corp.*, 195 *E. Merrick Rd., Freeport, Long Island, N.Y.*

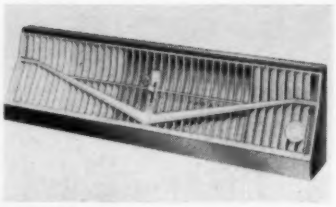
Enclosed in black enameled aluminum cases with brass slip rings to permit installation for adjustable angle, rigid or remote reading; available in standard ranges from −40 to 350 F.



Level Indicator . . .

. . .featuring simplicity of installation and removal of glass indicating column—*Petrometer Corp.*, 43-22 *Tenth St., Long Island City* 1, *N.Y.*

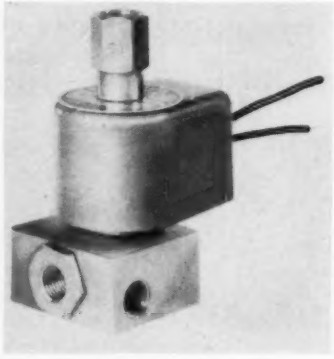
Glass column is held in position by two receptacles at top and bottom of indicator; to remove glass tube after draining liquid from it, push up against spring action of upper receptacle, tilt tube out of line of bottom receptacle and pull down.



Air Diffuser . . .

. . .in 18 in. overall length—*Air Control Products, Inc., Coopersville, Mich.*

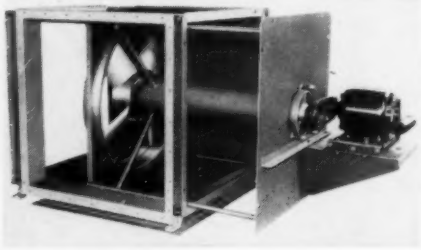
Constructed with high impact polystyrene face; 38 sq in. of free area; bulletin "267-AC" available on request.



Solenoid Valves . . .

. . .providing tight seating on air, water, light hydraulic oil up to 160 psi—*Automatic Switch Co., Florham Park, N.J.*

Valves may be mounted in any position without affecting operation; has ¼ in. diam exhaust orifice; descriptive bulletin "8317 (Form No. V5072)" available.



Elbow Fans . . .

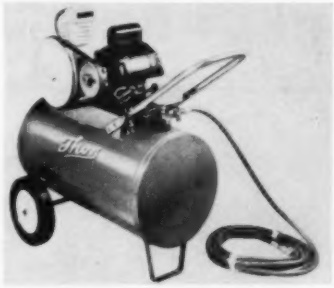
. . .with capacities from 600 to 32,000 cfm at static pressure to 2 in. or more—*L. J. Wing Co., Div. Aero Supply Mfg. Co., Inc.*, 140 *Vreeland Mills Rd., Linden, N.J.*

Fans have adjustable-pitch V-belt to permit field adjustment of capacity to suit actual or changed conditions; standard fans handle up to 750 F.

Hydrogen Purifier . . .

. . .to separate hydrogen from other gases under pressures to 150 psi—*Serfass Corp.*, 1300 *E. Mermaid Lane, Philadelphia* 18, *Pa.*

Uses palladium-silver alloy permeable only to hydrogen and deutrium; purifier has capacity of 15 cfh of H_2 at a differential pressure of 100 psi.



Portable Air Compressor

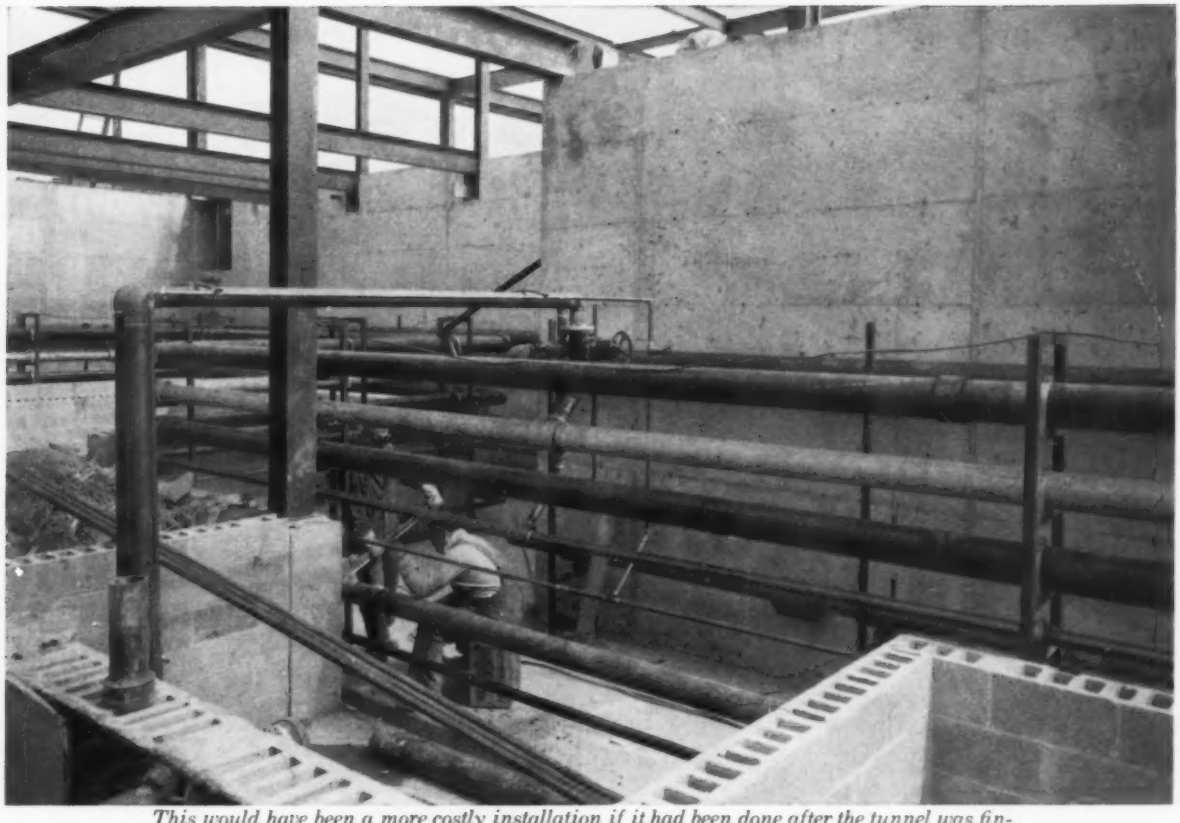
. . .for powering air tools, sprayers, job site applications requiring compressed air—*Speedway Div., Thor Power Tool Co.*, 1421 *Barnsdale Rd., LaGrange Park, Ill.*

Provides up to 150 psi air pressure and is equipped with 12 gal capacity air tank; compressor has heavy-duty 20 ft air hose with air chuck and is powered by ½ hp shock-resistant air hose.

Gas Vents, Chimneys . . .

. . .featuring interlocking joints—*General Products Co., Inc., Fredericksburg, Va.*

Vent pipe slips together, locks firmly with "snap" action; venting designed with curled end to give pipe additional strength; precision designed adapter permits effective conversion from round to oval pipe.



This would have been a more costly installation if it had been done after the tunnel was finished. But, using the UNISTRUT framing system, the awkward, time consuming work was eliminated because piping could be installed while there was still plenty of elbow room.

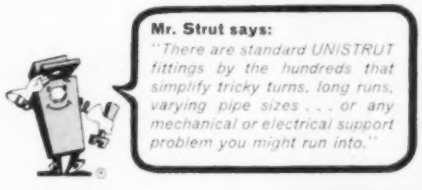
Install piping while there's room to work!

How UNISTRUT framing cuts construction costs

UNISTRUT channels and fittings enable you to erect pipe racks in place before the walls are up. With plenty of working room, piping can be easily handled and placed in position on the racks. Coupling or welding of the pipes is then a simple matter.

And the job is done better. The patented UNISTRUT clamping nut makes possible accurate adjustment of the pipe racks for proper pitch and readily permits job site changes. Result is a neat, space-saving, precision job in far less time than by conventional methods.

Because it cuts construction costs, UNISTRUT framing is specified by leading utility companies and the largest architectural and engineering firms. Your local Unistrut distributor carries complete stocks to guarantee fast local service. Expedite your next job by calling him now.


Mr. Strut says:
"There are standard UNISTRUT fittings by the hundreds that simplify tricky turns, long runs, varying pipe sizes . . . or any mechanical or electrical support problem you might run into."

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Stocking distributors in all principal cities of the United States and Canada. Exported throughout the world.

how to seal a sale...

This ARI Seal of Certification on unitary* air-conditioning equipment tells you—and your prospects—that it meets its published standards of performance.

With the ARI Seal on a unit, you can specify it with complete confidence. You know that the unit is built and backed by one of 46 companies who manufacture 90% of all unitary equipment sold. You know it is subject to intensive laboratory testing under adverse conditions and is rated to perform at maximum cooling capacity in the hottest, most humid weather.

ARI-certified equipment makes it easier for you on any job. It is easier to sell and to maintain. Once installed, you'll have fewer complaints from customers, fewer service calls, less repair and replacement expense—fewer headaches all around.

The ARI Seal of Certification on unitary equipment is an excellent sales closer. Put it to work for you next time you talk to a prospect.

*"Unitary" air conditioners included in this program: all packaged air conditioners, whether single units or two-piece units (called "split" systems) up to 135,000 B.T.U.'s per hour in capacity, but not including room air conditioners. ARI Standard 210-58 for electrically-driven equipment; ARI Standard 250-58 for heat-powered equipment.

this seal helps you sell

For free explanatory booklet and Directory of participating manufacturers, write to: Chief Engineer, Dept. H-201, Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N.W., Washington, D.C.

NEW!

improved

CCVS

SUPERIOR FEATURES

- Vertical close-coupled pump and motor unit bolted to receiver.
- Cast iron receiver for long wear.
- Low return inlets for convenient piping of return close to floor.
- Two receiver inlets on side and top of receiver.
- Stainless steel motor shaft prevents corrosion.
- Quiet operation is proof of vertical pump design.
- Installation on floor level or in pit.
- Mechanical shaft-seal eliminates all leakage from pump shaft.
- No close clearance, efficiency is maintained even at 3500 RPM motor speed.
- Completely assembled ready for return and discharge connections.

There's a wide range of types and capacities for every heating pump need. Let Skidmore advise you on your next tough job.

TYPE UV

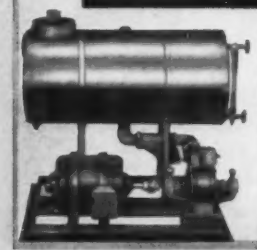
Type UV Condensation Pump is designed for below floor level returns, and is built in single and duplex units.

Write for *Bulletin No. 19-A*

TYPE HS

Type HS Pump is recognized for its dependable low operating cost. Capacities range from 1,000 to 65,000 sq. ft. EDR and pressures from 10 to 75 pounds.

Write for *Bulletin No. 14-A*



TYPE TM

Type TM High Pressure Turbine Pump. Designed for pressures up to 150 pounds and boilers to 250 H.P.

Write for *Bulletin No. 17*

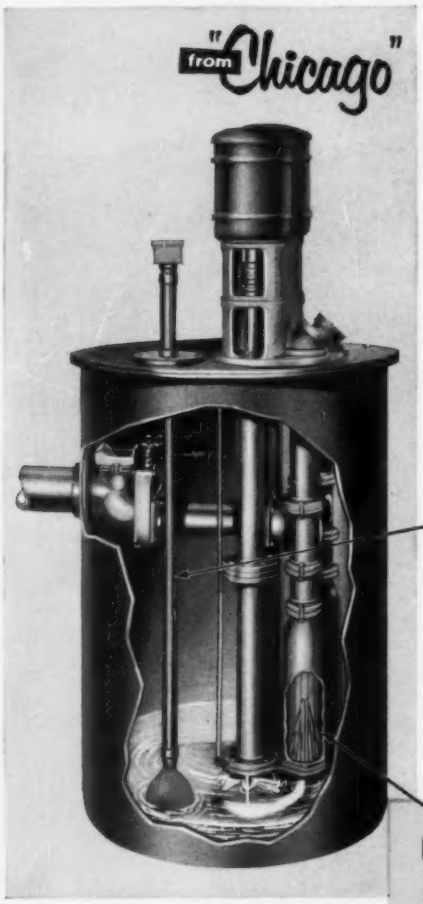
Call the nearest Skidmore representative or write for Bulletin 21-C.

Representatives In All Principal Cities

SPECIFY

SKIDMORE PUMPS

SKIDMORE CORPORATION ST. JOSEPH, MICHIGAN



"from Chicago" . . . the NEW FLUSH KLEEN® story

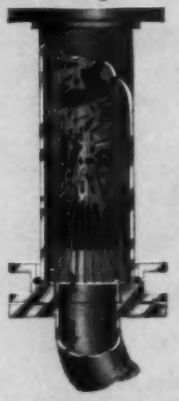
better than ever FLUSH KLEEN® clog-proof sewage pumping

NOW available with . . .

New SEALTRODE*

Sealed Electrode Floatless Pump Controller . . . the *only* pump controller *completely* free of becoming insulated or coated with grease or corrosive elements found in sewage and drainage water.

New FLO-THRU* Strainer . . . the heart of the FLUSH KLEEN® System, is now available with FLUSH KLEEN® Sewage Pumps. Clear liquid flows continuously around and through the strainer without obstruction . . . at maximum solids loading.



High Wet Strength Paper Products and other solids . . . are never a problem.

Other Features

- Pumps handle clear liquid only
- Dependable, trouble-free pumping performance
- Minimum maintenance
- 100% standby capacity
- Longer pump life

OVER 13,000 FLUSH KLEEN® INSTALLATIONS

1959 50 YEARS CHICAGO PUMP COMPANY 1909

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Putting Ideas to Work

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Chicago Pump Company

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EQUIPMENT DEVELOPMENTS

Continued

Masonry Drill . . .

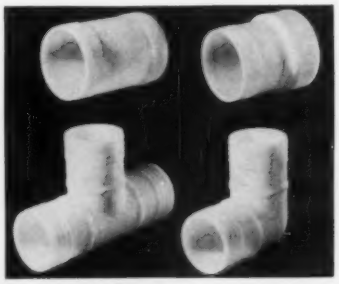
. . . with penetration rates up to 6 in. per minute — *Kor-It Co., Inc.*, 991 *Richard Ave., Santa Clara, Calif.*

Drill has 360 deg swivel adjustment to drill holes at any angle up to 6¼ in. in diam; swivel head and drill can be mounted on standard pipe; descriptive bulletin available.

Power Screwdriver . . .

. . . featuring mechanism to permit depth control in driving screws to pre-determined settings—*Black & Decker Mfg. Co.*, 628 *Pennsylvania Ave., Towson* 4, *Md.*

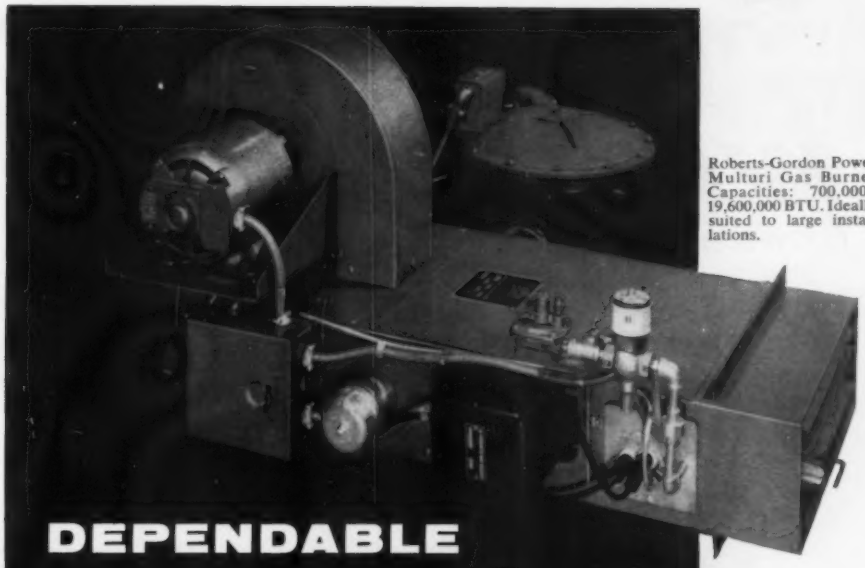
Standard speed without load is 800 or 660 rpm; can be supplied with or without reversing switch.



Pipe Fittings . . .

. . . with applications in industrial piping, air conditioning systems—*Plastiline, Inc.*, 2 *Intervale St., White Plains, N.Y.*

Fittings are inert-type for use on plastic pipes; available in sizes up to 4 in.



Roberts-Gordon Power Multuri Gas Burner Capacities: 700,000 - 19,600,000 BTU. Ideally suited to large installations.

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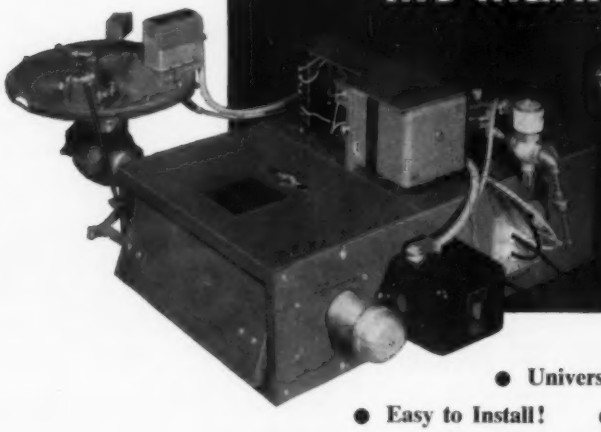
the mark of ROBERTS GORDON BYDAND GAS BURNERS!

Roberts-Gordon Multuri Atmospheric Gas Burner Capacities: 700,000 - 9,450,000 BTU. Extremely quiet operation.



- **Universal Adaptability!**
- **Built-In Dependability!**
- **Easy to Install!**
- **Minimum Maintenance!**
- **All Components Readily Accessible for Routine Servicing!**
- **Packaged Units, Factory Wired and Completely Assembled!**

Your reputation as a heating expert is at stake every time you recommend and install a gas burner. You protect that reputation and add to your prestige when you select these famous Roberts-Gordon Multuri Gas Burners for your commercial and industrial installations.

Every last detail of advanced design of these Roberts-Gordon Multuri Gas Burners assures top efficiency and the very minimum of service costs.

Don't be tempted to put in something less. Get DEPENDABLE PERFORMANCE. Install famous Roberts-Gordon.

Custom Engineering Service

In addition to standard Multuri Burners (capacities above) larger units or specially-designed burners can be supplied to fit your needs. No problem is too big or too specialized — Roberts-Gordon offers the finest Custom Engineering Service to meet your needs.

Get the facts now. You'll be 'way ahead when you install famous Roberts-Gordon Gas Burners.

Write for name of nearest factory representative. Sales and service coast-to-coast in U.S. and Canada.

ROBERTS-GORDON
"Spreader-Flame"
Gas Fired UNIT HEATERS

- Compact!
- Fast Heating!
- Lightweight!
- Economical!
- Quiet, Efficient Operation!

Aluminized steel heat exchanger with all welded tubes assures long, trouble-free life.

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Grimsby, Ontario

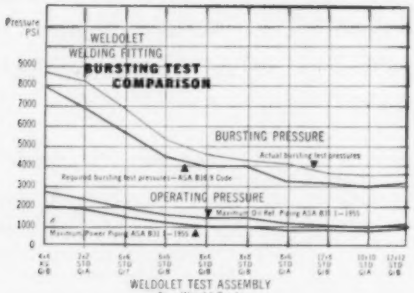
new redesigned BONNEY WELDOLETS

for reinforced branch connections on carbon steel and alloy pipe

Welding fittings manufactured and tested in accordance with ASA B16.9 and ASA B31.1

clean-cut bevel with exactly 1/16" land
bore machined with a watchmaker's precision and finish
reduced angle of bevel ... weld volume cut almost 50%
weld line clearly defined ... no more errors about "how much to weld"
skirt taper redesigned for improved stress distribution

RESULTS? OVER 4½ TIMES MAXIMUM OPERATING PRESSURE



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THREDOLETS®
SOCKOLETS®
ELBOLETS®
BRAZOLETS®
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CARBON STEEL
STAINLESS
ALLOY
for all services

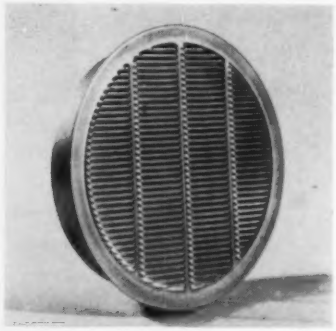
For high strength and low-total installed cost compare with . . . other reinforced branch construction . . . unreinforced branch construction . . . and welding tee construction. Then specify and use Weldolet fittings for all full size and reducing branch connections.

BONNEY FORGE AND TOOL WORKS

ALLENTOWN, PENNSYLVANIA

EQUIPMENT DEVELOPMENTS

Continued



Aluminum Louver . . .

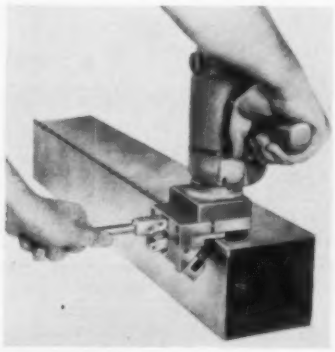
. . . suitable for outdoor and marine installations—*Midget Louver Co., 6 Wall St., Norwalk, Conn.*

Available in six sizes from 1 to 4 in. diam; grille openings are smaller than regular screening, eliminating need for additional screen unit; features ease of installation.

Air Filter Signal . . .

. . . to automatically indicate when to change or clean filters on air conditioning, air handling, forced warm air systems — *Viking Instruments, Inc., East Haddam, Conn.*

Filter signal installs on blower enclosure between filters and blower; as filters become dirty and clogged, blower sucks air through signal which gradually builds up audible whistling alarm.



Duct Fabricator . . .

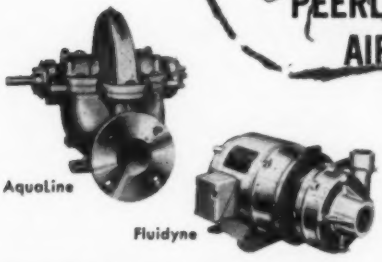
. . . to produce ducts more quickly on the job—*Millers Falls Co., 57 Wells St., Greenfield, Mass.*

May be used on 18 to 28 gage metal with speeds ranging from 18 to 30 fpm, depending on thickness of metal being fabricated.

THESE QUALITY PUMPS CUT COSTLY SERVICE CALLS

PEERLESS PUMPS

PEERLESS END SUCTION AND SIDE SUCTION AIR CONDITIONING PUMPS COST LESS—LAST LONGER



AquaLine

Fluidyne

PEERLESS AQUALINE® Pumps are available in sizes to 8-inches. Capacities to 2600 gpm, heads to 280 feet. Temperatures to 250°F. Horizontal split case design allows quick inspection without disturbing piping.

PEERLESS FLUIDYNE® Pumps are compact end-suction design. Redi-Packed in 22 sizes from 1 x 2 x 6 to 2½ x 3 x 10, for immediate shipment. Heads to 230 feet, capacities to 300 gpm, motors from 1 to 15 hp.

If there is a key word to describe Peerless Pumps, that word is QUALITY. You'll find it in the way the pumps are designed. You'll find it in the way the pumps are made. And you'll find it most apparent in the way these pumps operate. Remarkably long trouble-free operating records are routine with these better-made pumps.

But QUALITY is just the start of a long list of important features that recommend the Peerless AquaLine and Fluidyne line of pumps for your water handling jobs. There's immediate availability from ready-to-ship stocks. Complete hydraulic coverage for every type of application. Compact streamlined design that gives you space-saving good-looking layouts. And fast, on-time service from a network of warehouses and field offices. Get the full story of these superior pumps. Request more information today.

ATTENTION DEALERS: A limited number of Peerless AquaLine and Fluidyne pump dealerships are available. Please write for complete information.

Putting Ideas to Work

fmc

Peerless Pump Division

Offices:

New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

Distributors in principal cities.
Consult your telephone directory.

PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION
2005 Northwestern Avenue, Indianapolis 8, Indiana

Gentlemen: Please send me immediately:

- ☐ Bulletin B-2319 on Peerless Fluidyne Pumps.
- ☐ Bulletin B-2100 on Peerless Aqualine Pumps.
- ☐ Name and address of nearest Peerless Dealer.

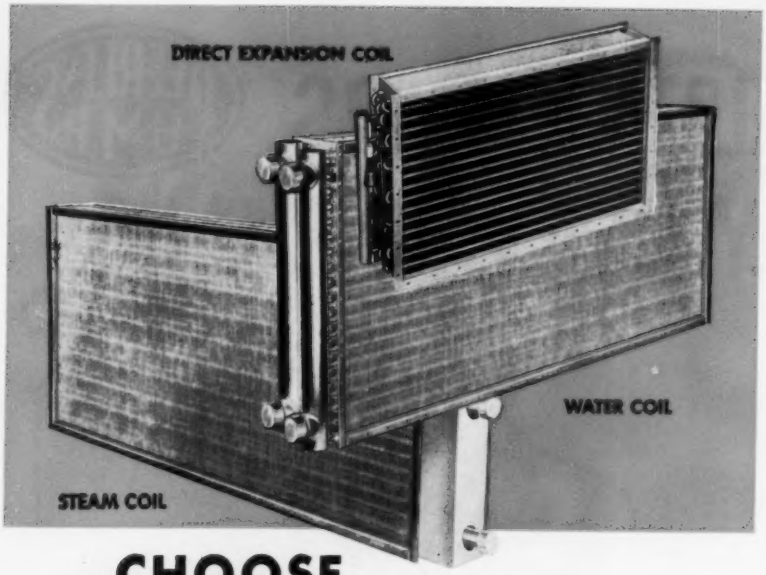
Name_____

Address_____

City_____

State_____

HPAC



CHOOSE BOHN KNOWN-CAPACITY COILS

ALL BOHN COILS are ruggedly built...

- Die-formed plate-type aluminum fins . . . from 4 to 14 per inch . . . with self-spacing collars completely covering the tubes. Permanent, tight, metal-to-metal fin-tube bond.
- Heavy-gauge casings die-formed from galvanized steel.
- Headers of heavy-wall seamless copper tube with heavy die-formed end caps. High pressure tested at 320 psig. minimum air pressure under warm water.
- Tested and rated according to ASRE-ASHAE standard 33-58.

IN ADDITION...

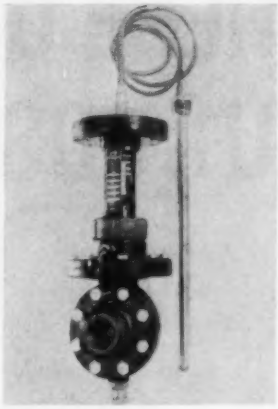
DIRECT EXPANSION COIL—Type DE, insures equal distribution of refrigerant with brass pressure-type distributors;
WATER COIL—in Types WH, WF, and WD, is drainable in every type;
STEAM COIL—in Types S, NFS, and NFO, has condensing tubes pitched in casing a minimum of ⅛" per foot of tube length, as well as orificed steam supply tubes, and coil tubes floating free within coil casing to prevent stress and strain on tubes and joints . . . maximum operating pressure 200 psig. at 400°F.

A Memo from BOHN:
"We are one of the largest manufacturers of specially designed evaporators and condensers for Original Equipment Manufacturers of refrigeration and air conditioning units and systems."

For full information, call or write to Bohn

BOHN *Buy the known line... the BOHN line*
Aluminum and Brass Corporation
Danville Division, Danville, Illinois

EQUIPMENT DEVELOPMENTS
Continued



Control Valves . . .

. . . for process heating and cooling applications—*OPW-Jordan Corp., 6013 Wiehe Rd., Cincinnati 13, O.*

Available in ¼ to 2 in. sizes in ductile iron and bronze bodies; suitable for pressures to 250 psi and temperatures to 500 F; 10 temperature control ranges from 35 to 450 F; capable of control with pressure differential across seats of 125 psi; descriptive bulletins "SRBc 64-59" and "JNP-2" available on request.

Motor Controls . . .

. . . for use where slight a-c hum or electrically held contactor might be objectionable—*Arrow-Hart & Hegeman Electric Co., Industrial Control Div., 103 Hawthorn St., Hartford 6, Conn.*

Controls are electrically operated switches that are closed by momentary energization of coil, then held in closed position by mechanical latch; frequently used in motor control circuits where continuity of operating sequence must be maintained.

Electric Baseboard . . .

. . . featuring built-in thermal overload protector which operates when front of unit is blocked for its entire length—*Emerson Electric Mfg. Co., 8100 Florissant Ave., St. Louis 36, Mo.*

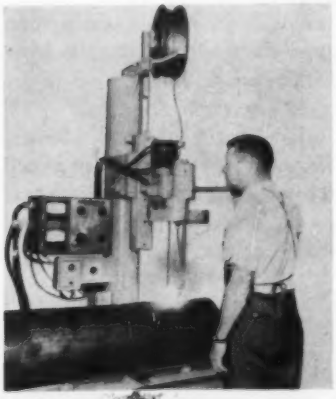
Designed to develop 250 watts per ft or 850 Btu per ft; available in 3, 4, 6, 8 ft sizes; units are constructed so that heated air moves away from wall preventing heat streaks.

EQUIPMENT DEVELOPMENTS
Continued

Plastic Tape . . .

. . . to seal and permanently lubricate threaded and coupled pipe joints—*Minnesota Mining and Mfg. Co., Irving Div.*, 900 *Bush Ave., St. Paul 6, Minn.*

Tape conforms to all types of pipe threads and fittings in any pipe system, low pressure or high, according to manufacturer; available in ½ in. width in 260 or 520 in. lengths.



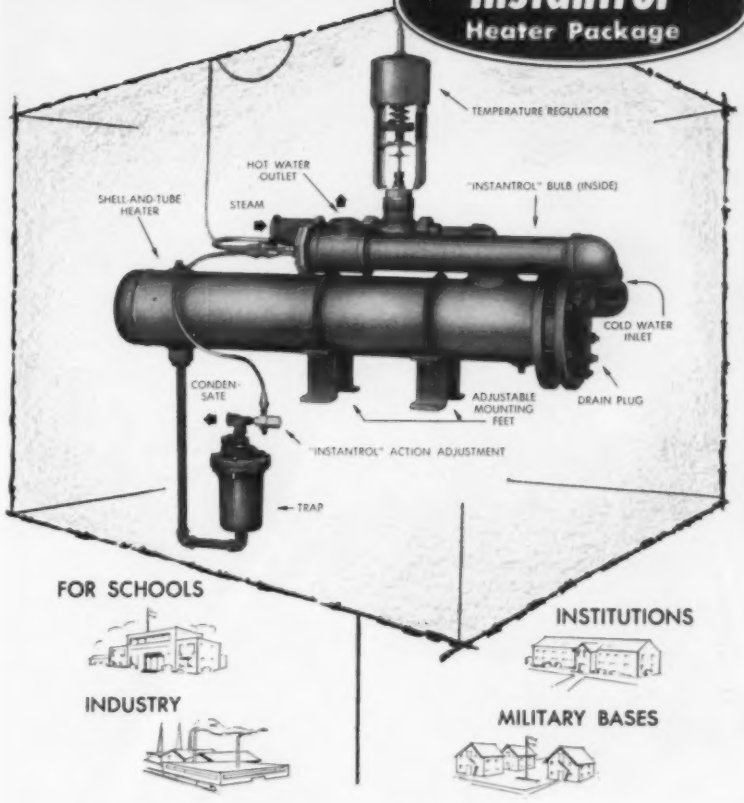
Welding Machine . . .

. . . to weld blank or threaded spuds to water tank head—*Leonard Precision Products Co.*, 9200 *Bolsa Ave., Santa Ana, Calif.*

Complete circle weld can be accomplished on ¾ in. spud in four seconds; length of automatic weld time is adjustable to circumference of spud around which welding head must travel; by interchanging of spud locator adapters, spuds as small as ½ in. and as large as 4 in. diam are welded; tank conveyor accommodates tanks ranging in size from 12 to 20 in. in diam.

Instant Hot Water Under Perfect Control
At Varying Loads!

Instantrol™ Heater Package



Take the cost-saving, space-saving advantages of instantaneous shell-and-tube heaters . . . add *positive control* of heated liquids regardless of peak loads or long stand-by periods . . . and this Instantrol Heater Package is *it!*

The heat-anticipating effect of Robertshaw's exclusive Instantrol® bulb assures extremely close control of temperature, no matter how often or how sharply the load varies. Tight-closing "MA" valve prevents temperature build-up.

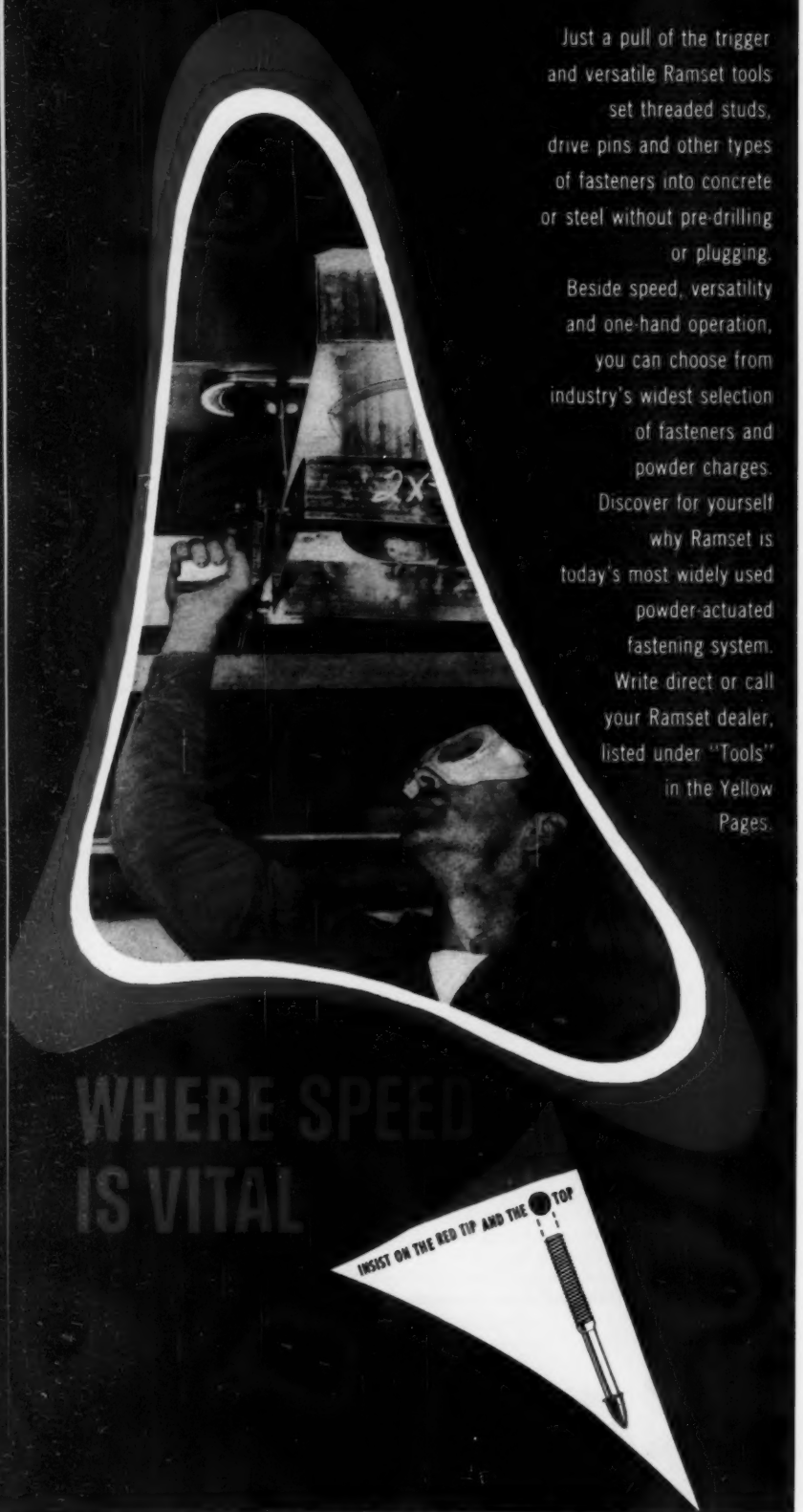
Ideal for showers, washrooms, dishwashers, industrial processes and countless other needs, the Instantrol Heater Package is simple in design, ruggedly built, easily installed. Needs as little as 16″ x 50″ floor space, or can be wall-mounted. Standard components, replaceable thermal assembly, adjustable temperature, three standard ranges, temperature control with load "reset."

Detailed specifications free in Bulletin CH-758. **Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 1, Tenn.**

Robertshaw

MR. CONTROLS

leading contractors use Ramset



Just a pull of the trigger and versatile Ramset tools set threaded studs, drive pins and other types of fasteners into concrete or steel without pre-drilling or plugging. Beside speed, versatility and one-hand operation, you can choose from industry's widest selection of fasteners and powder charges. Discover for yourself why Ramset is today's most widely used powder-actuated fastening system. Write direct or call your Ramset dealer, listed under "Tools" in the Yellow Pages.

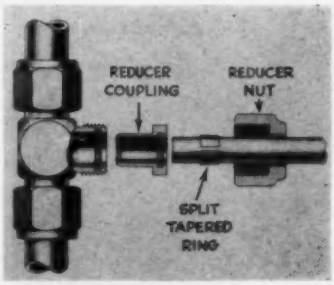
WHERE SPEED IS VITAL

Ramset® Fastening System

OLIN MATHIESON CHEMICAL CORP. · WINCHESTER-WESTERN DIV. · 291-B WINCHESTER AVE. · NEW HAVEN 4, CONN.

EQUIPMENT DEVELOPMENTS

Continued



Reducer Couplings . . .

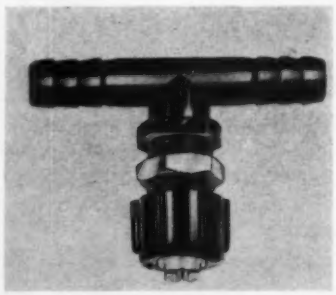
. . .to reduce or increase tube size as necessary at various points in piping systems — *Lenz Co., Dept. N-63, 3301 Klepinger Rd., Dayton 1, O.*

Leakproof assembly provides dependable seal under conditions of shock or vibration, according to manufacturer; applicable to tubing of any thickness and can be disassembled and reassembled any number of times with all parts reusable; can be used with unions, elbows, tees, crosses, and bulkhead connections.

Brazing Alloys . . .

. . .used in joining aluminum, iron, copper, other alloys—*All-State Welding Alloys Co., Inc., 249-55 Ferris Ave., White Plains, N.Y.*

Includes low melting silver brazing rod, phosphor-copper brazing rod, silver-bearing phosphor-copper brazing rod; descriptive literature available.



Connector Nozzles . . .

. . .of nylon designed for corrosion resistance — *Delavan Mfg. Co., 811 Fourth Ave., West Des Moines, Ia.*

May be used with ½ in. corrosion resistant hose with single or channel iron boom; available as "T" or double hose inlet, and "L" or single hose inlet.

this **WALKER SHUR-FLO** Draft Inducer-Regulator Unit...

ENDS DRAFT PROBLEMS RIGHT FROM THE START...

MODELS For Gas... Oil... and Solid Fuels!

"I don't fuss and fret with uncertain draft anymore since Walker brought out this low-priced draft inducer-regulator combination. Now, I install Walker inducers on all my jobs. That puts me way out ahead, because with good draft I know every job will be exactly right from the start."

THE INSIDE STORY OF SHUR-FLO EFFICIENCY

- Hi Volume Self-Feathering Fan
- Self-Cleaning Blades (No soot build-up)
- Stainless Steel Shaft, Hub, and Blades
- Quiet, burn-out proof motor
- Silicone oiled Bearings
- Extra heavy gauge galvanized steel construction
- Extra rigid mountings.

"Most Efficient Draft System Ever Made"

Say Heating Contractors, Architects, Home Owners

Draft problems end with Walker Shur-Flo (Pats. Pend.), SUREST DRAFT SYSTEM EVER DEVISED for oil, coal or gas-fired installations from older homes to modern, low-roofed houses. Install it, forget it! What could be better?

Fan-operated draft-inducer draws *only* flue gases — *not* outside air. Quiet. Costs less to operate. Needs little power. Installs quickly at *any* angle. Virtually eliminates costly call-backs, corrections.

For full details, see your supplier or write direct

WALKER MFG. AND SALES CORP.

1720 Penn Street St. Joseph, Missouri

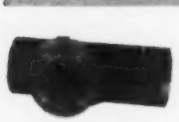
Free!

"HOW TO CURE SICK CHIMNEYS"

Now, the *first* ready-reference guide collecting *all* the information on Power Inducer Venting you'll need to solve your draft problems. You'll find it indispensable. Get your handy copy *now!* Absolutely no obligation.

WRITE TO US AT ADDRESS AT LEFT

Scientifically Designed Walker Draft Controls for Every Draft Purpose Are Standards of the Industry. 30,000,000 in Use Prove Efficiency.

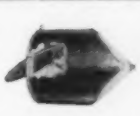


ROYAL PURPLE for smaller central heating plants

BALANCED 34 for larger, special central heating

JUNIOR LINE central heating budget control

TYPE BB commercial and industrial control

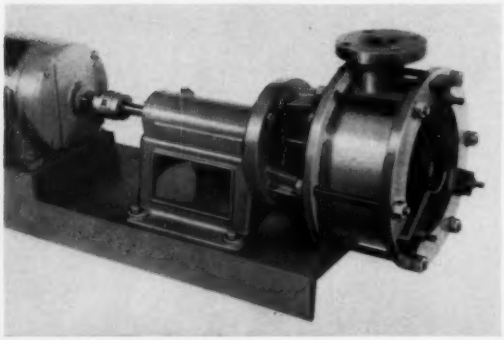


DOUBLE SWING for gas fired equipment

VENTURI CAP for heating and ventilating

EQUIPMENT DEVELOPMENTS

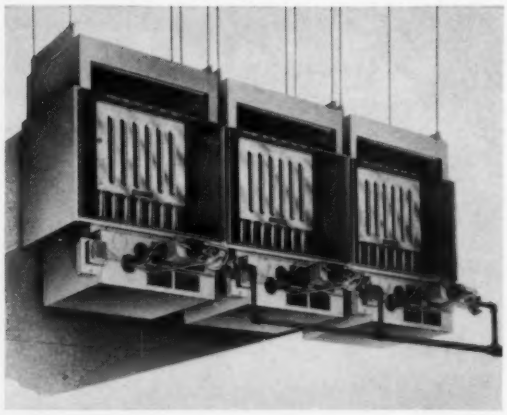
Continued



Centrifugal Pumps . . .

. . . with resistance to solvents, greases, oils, chemicals —*Vanton Pump & Equipment Corp.*, 201 *Sweetland Ave., Hillside, N.J.*

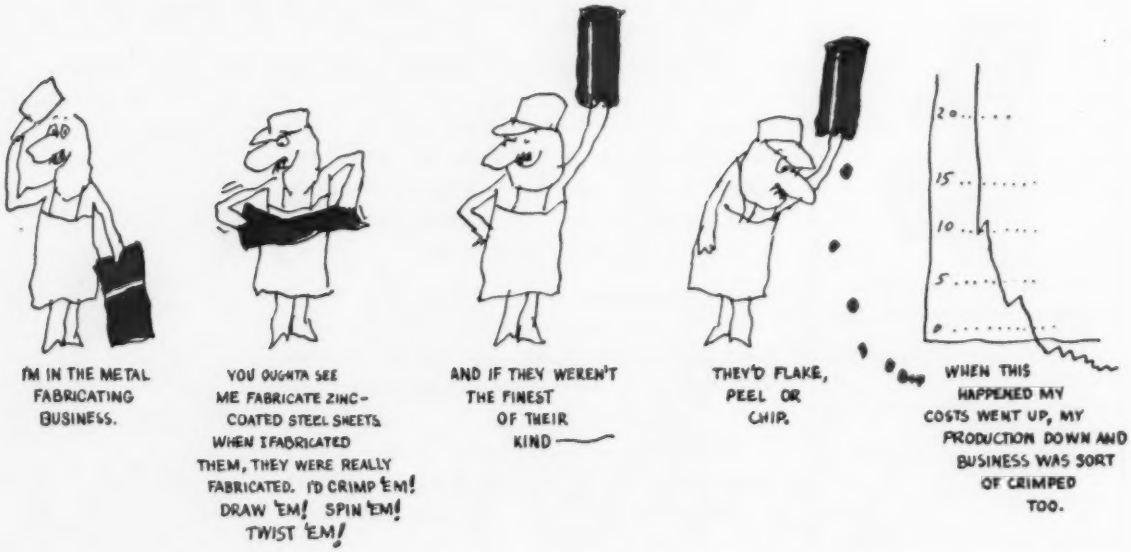
Available in two sizes in capacity range from 2 to 80 gpm; pumps can handle solution temperatures up to 300 F; molded impellers are of dynamically balanced design; polypropylene casing is protected by cast iron frame.



Duct Furnaces . . .

. . . with special features for air conditioning applications—*Modine Mfg. Co.*, 1509 *De Koven Ave., Racine, Wisc.*

Units incorporate removable air by-pass baffles which eliminate need for adding by-pass ducts to handle greater cfm required for cooling; available in six models from 75,000 to 300,000 Btu per hr input; may be used with natural and mixed gases and LP gas-air mixture; descriptive bulletin "659-B" available on request.


I'M IN THE METAL FABRICATING BUSINESS.
YOU OUGHTA SEE ME FABRICATE ZINC-COATED STEEL SHEETS. WHEN I FABRICATED THEM, THEY WERE REALLY FABRICATED. I'D CRIMP 'EM! DRAW 'EM! SPIN 'EM! TWIST 'EM!
AND IF THEY WEREN'T THE FINEST OF THEIR KIND—
THEY'D FLAKE, PEEL OR CHIP.
20
15
10
5
0
Day
WHEN THIS HAPPENED MY COSTS WENT UP, MY PRODUCTION DOWN AND BUSINESS WAS SORT OF CRIMPED TOO.

Pump Package . . .

. . . with variable high-turn-on control to eliminate frequent pump cycling —*Kenco Pump Div., American Crucible Products Co.*, 1305 *Oberlin Ave., Lorain, O.*

Package features watertight design for operation in humid atmospheres or where flooding of power source is apt to occur; available with submersible pump with capacity of 3300 gph at 10 ft discharge head or with capacity of 5000 gph at 10 ft head.

Pitot Tubes . . .

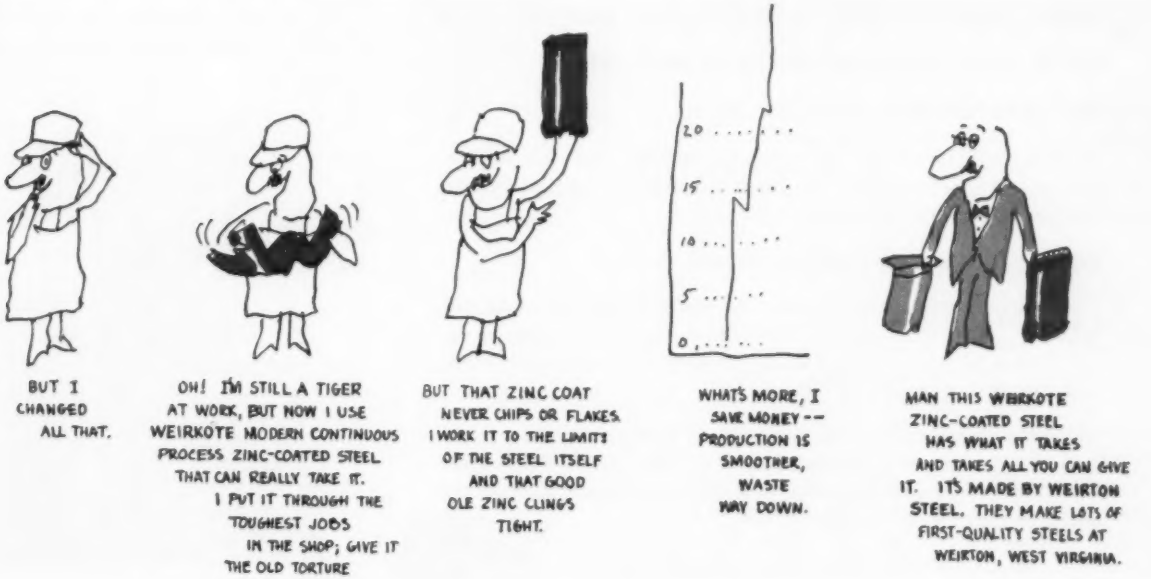
. . . for use in ducts as small as ½ in. diam—*F. W. Dwyer Mfg. Co., Dept. HA-8, P.O. Box 373, Michigan City, Ind.*

Tubes are fabricated from hypodermic needle grade stainless steel with ⅛ in. OD and overall lengths of 6 or 12 in.; according to manufacturer, give excellent results in duct diameters of 4 in. or less and will perform comparably with standard size tubes in any duct where insertion of not more than 12 in. is required; may be used in temperatures up to 800 F, available with variety of mountings.

Pipe Fitting Tool . . .

. . . for use with copper tubing and piping systems—*Erie Tool Works, 735 W. 12th St., Erie, Pa.*

Device draws tee from copper tubing in less than five minutes; can be used on installed lines without disassembly; reduces number of reducing tee fittings and soldered joints required, according to manufacturer.


BUT I CHANGED ALL THAT.
OH! I'M STILL A TIGER AT WORK, BUT NOW I USE WEIRKOTE MODERN CONTINUOUS PROCESS ZINC-COATED STEEL THAT CAN REALLY TAKE IT. I PUT IT THROUGH THE TOUGHEST JOBS IN THE SHOP; GIVE IT THE OLD TORTURE TREATMENT.
BUT THAT ZINC COAT NEVER CHIPS OR FLAKES. I WORK IT TO THE LIMIT? OF THE STEEL ITSELF AND THAT GOOD OLE ZINC CLINGS TIGHT.
20
15
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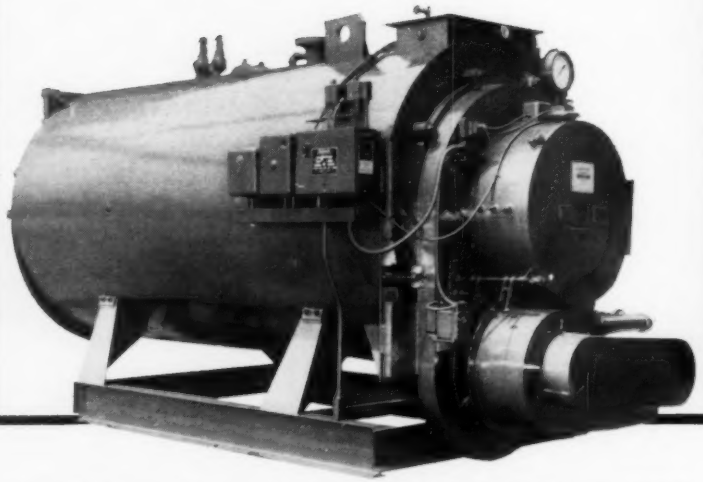
5
0
WHAT'S MORE, I SAVE MONEY -- PRODUCTION IS SMOOTHER, WASTE WAY DOWN.
MAN THIS WEIRKOTE ZINC-COATED STEEL HAS WHAT IT TAKES AND TAKES ALL YOU CAN GIVE IT. IT'S MADE BY WEIRTON STEEL. THEY MAKE LOTS OF FIRST-QUALITY STEELS AT WEIRTON, WEST VIRGINIA.

WEIRTON STEEL *Weirton Steel is a division of* **NATIONAL STEEL CORPORATION**

Continental AUTOMATIC BOILERS

2-PASS DESIGN...



WHY THIS 2-PASS AUTOMATIC BOILER CAN GIVE YOU LOWER OPERATING AND MAINTENANCE COSTS...

In the simplified, compact design of Continental 2-Pass Automatic Boilers, you get the most practical and economical approach to heat transfer available in packaged boilers today.

HERE'S JUST ONE IMPORTANT DIFFERENCE:

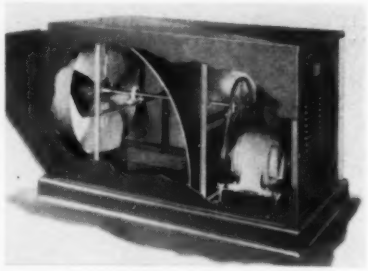
Continental's 2-Pass design eliminates the need for refractory baffles and brickwork. There is *no* danger of hot gases short-circuiting direct to the stack. You eliminate costly maintenance problems and your boiler operates with low stack temperature always.

The cost-saving performance of these compact boilers is today recognized by industrial concerns and institutions of all types. All the facts on the Continental are presented concisely in a new bulletin that's yours for the asking. Write today for Bulletin BE-400.

- 15 to 600 HP Steam Boilers—to 250 PSI
- Hot Water and HTW Boilers
- Oil, Gas, Combination Oil/Gas

CONTINENTAL BOILER DIVISION
BOILER ENGINEERING & SUPPLY COMPANY, INC.
Phoenixville, Pennsylvania

EQUIPMENT DEVELOPMENTS
Continued



Roof Ventilators . . .

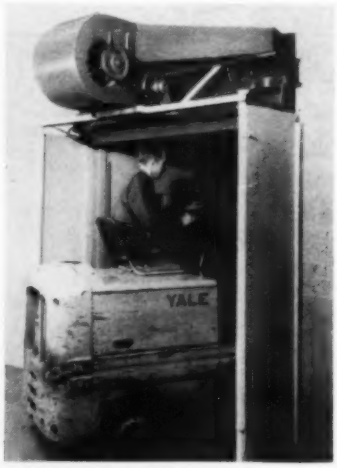
. . . for industrial and commercial use —*Romla*, 13101 *S. Main St., Los Angeles* 61, *Calif.*

Available with spark-proof aluminum alloy high-speed propeller fan blade for industrial processing and drying systems; wide blade, slow-speed steel propellers available where air must be exhausted against lower resistance.

Seam Adapter . . .

. . . for small air hammers—*Superior Pneumatic & Mfg. Inc.*, 13800 *Enterprise Ave., Cleveland* 35, *O.*

Operators require no special training or skill, according to manufacturer; adapter handles 14 to 22 gage metals.



Cold Air Wall . . .

. . . for installation to walk-in freezers, pass-through doors, cold storage plants—*Lehigh Mfg. Co.*, 1500 *Lehigh Dr., Easton, Pa.*

Cold air from room drawn into unit by fan, then forced downward blanketing entire doorway; available for 3, 4, 5, 6, 8 ft doorways.

RECENT TRADE LITERATURE

▸ *AIR CLEANER*—to eliminate smoke, dust, pollen from ventilating systems; bulletin "405" contains diagrams, specifications. *Dollinger Corp., 9 Centre Park, Rochester 3, N.Y.*

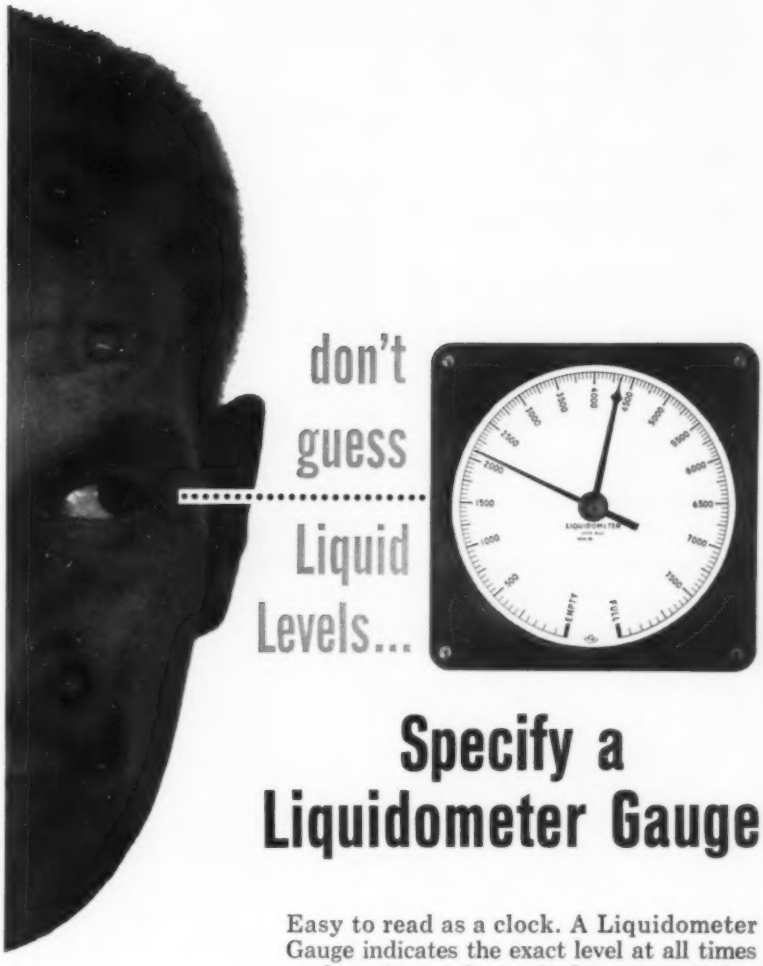
▸ *AIR CONDITIONING CATALOG*—for architects, engineers, contractors; contains complete 1960 line of air handlers, evaporative condensers. *Catalog Publications Section, Drayer-Hanson Div., National-U. S. Radiator Corp., 3301 Medford St., Los Angeles 63, Calif.*

▸ *AIR FILTERS*—bulletin "207" describes washable unit air filters, special filters used with radar, electronic cabinet ventilation; includes charts, installation data, dimension drawings, maintenance methods. *American Air Filter Co., Inc., Dept. PD, 215 Central Ave., Louisville 8, Ky.*

▸ *AIR HANDLING SYSTEMS*—short forms available to enable engineers and contractors to determine type and number of silencing units required for any air handling system; consists of binder and pad of 25 reproducible work sheets available at $1.00 per copy. *Industrial Acoustics Co., 341 Jackson Ave., New York 54.*

▸ *AIR METER*—for precision measurement of air velocity in industrial, commercial, laboratory applications detailed in catalog "170"; models available as low as 5 fpm or as high as 200 mph. *Hastings-Raydist, Inc., Hampton, Va.*

▸ *AIR SUPPLY SYSTEMS*—for blowing off chips, dust, other particles from machine surfaces described in new guide; includes information on performance and shows how effective blowing job can be accomplished. *U.S. Hoffman Machinery Corp., Dept. EJM, 103 Fourth Ave., New York 3.*



Specify a Liquidometer Gauge

Easy to read as a clock. A Liquidometer Gauge indicates the exact level at all times ...shows it at a glance. And gauge operation is completely automatic – as far as 250 feet from the tank – without need for auxiliary power of any kind.

A Liquidometer Tank Gauge measures virtually any liquid. It's simple to install – requires no maintenance. Many have provided over 30 years of efficient, dependable service. All are approved by Underwriters' Laboratories and Factory Mutual.

Whether your gauging needs require an automatic Liquidometer Gauge, a hydrostatic Levelometer or a tank-site-indicating Direct Reader, you'll get the best by specifying Liquidometer. For complete details write Dept. A.

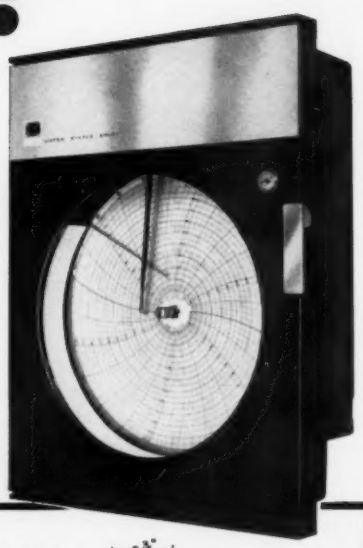
Since 1920 ...of proven quality

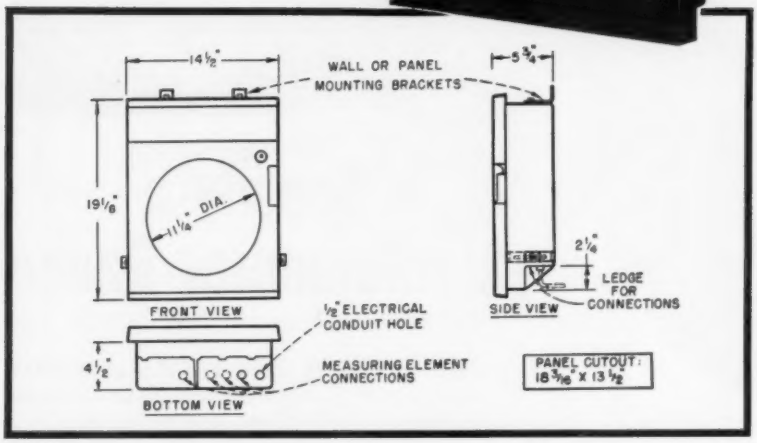
THE LIQUIDOMETER CORP.
LONG ISLAND CITY 1, NEW YORK

NEW!

MODERNIZED RECORDER HAS UNIVERSAL CASE for all mountings and connections

Also features largest chart opening in the industry





Now, the time-proved, field-proved United States Gauge 12-inch pressure and temperature recorder with completely new, trim, practical exterior design . . . including many important features found only on higher priced instruments. Now, outside and in . . . the USG Recorder offers still more quality, performance and advantages at a money-saving price.

Recessed back. Connections can enter case vertically or horizontally without special mounting.

Largest chart opening in the industry. 11¼-in. diameter for better visibility of chart. Shatterproof glass or blind door optional.

Removable door. New hinge pins permit easy removal of door for access to instrument.

Light weight. Cast aluminum case. Steel back plate provides rigid reference surface for components, prevents recording errors due to stress on case.

Modern design. Enhances modern equipment. Stainless steel escutcheon can be embossed with equipment manufacturer's name.

Fluorescent lighting optional. Ends overheating of case. Improved door skirt increases light on chart.

Dust ledge. Top and bottom. Protects door from dust, moisture.

Ball pivoted pen movements. Exclusive. For 1, 2, 3 or 4 pens.

Send for Bulletin 3025 today.

Find Your Honest Distributor in the "Yellow Pages"

UNITED STATES GAUGE ® USG

Division of American Machine & Metals, Inc. • Sellersville, Penna.

RECENT TRADE LITERATURE

Continued

▸ *AIR VALVES*—that function without air motors or mechanical linkage of any kind described in bulletin "K-46" which explains how control air pneumatically activates neoprene tubes encased in aluminum vanes; includes performance characteristics, dimensions, ratings. *Connor Engineering Corp., Danbury, Conn.*

▸ *ALUMINUM ELBOW*—data sheet contains description of features, applications in petroleum, chemical and industrial uses where piping is frequently changed or inspected. *General Aluminum Supply Corp.*, 1506 *Eastern Ave., Kansas City* 26, *Mo.*

▸ *AMMONIA VALVES*—catalog contains full specifications, dimensions, diagrammatic drawings of full line of valves. *Cyrus Shank Co.*, 4646 *W. 12th Place, Chicago* 50.

▸ *BASEBOARD CONVECTOR*—for use in apartments, institutions, offices described in catalog "4360"; includes capacity, typical installations, specification graphs, piping diagrams. *Young Radiator Co.*, 709 *S. Marquette, Racine, Wis.*

▸ *BRAZING*—features described in bulletin "20" as applied to various products and applications. *Handy & Harman*, 82 *Fulton St., New York* 38.

▸ *CAST IRON BOILERS*—in 33 sizes from 600,000 to 5.4 million Btu input for hot water and steam heating systems detailed in new catalog; contains dimensional drawings, specifications for each boiler. *Peerless Heater Co., Boyertown, Pa.*

▸ *CHECK VALVES*—in sizes from ½ to 20 in. or more for pressure ratings varying from 125 to 1500 psi described in bulletin "600"; includes charts of mechanical features. *Combination Pump Valve Co., Dept.* 241, 851 *Preston St., Philadelphia* 4, *Pa.*

RECENT TRADE LITERATURE

Continued

▸ *CHIMNEY DRAFT*—booklet available describing methods of correcting problems in drafts as well as causes of chimney failures; includes how to size and select right draft inducer. *Walker Mfg. & Sales Corp.*, 1717 *Penn St., St. Joseph, Mo.*

▸ *CIRCULAR DIFFUSERS*—and accessories described in new catalog; contains product information, specifications, performance charts. *General Air Products*, 14 *Factory St., Cedar Grove, N.J.*

▸ *COMMERCIAL INCINERATORS*—both built-in and portable detailed in bulletin "35-J-41"; contains selector tables and design data as well as specifications. *Morse Boulger*, 80 *Fifth Ave., New York* 11.

▸ *CONCRETE DRILLING*—manual contains instruction procedures for cutting openings of 1 in. or less in slab. *Flexicore Co., Inc.*, 1932 *E. Monument Ave., Dayton, O.*

▸ *CONDENSATION PUMPS*—in six basic models described in product bulletin "CP-600"; includes design features, general specifications, engineering data, dimension drawings, construction and operation details. *American Air Filter Co., Inc.*, 215 *Central Ave., Louisville* 8, *Ky.*

▸ *CONTROL SYSTEMS*—for motor centers detailed in bulletin "SPM-1-1159"; contains illustrated construction details, typical layouts and methods of figuring combinations, suggested specifications. *Automatic Control Co.*, 995 *University Ave., St. Paul* 4, *Minn.*

▸ *CONTROL VALVE*—for zeolite softeners, ion exchange units, filters is subject of bulletin "WC-122"; includes schematic drawings of flow as guide to valve construction. *Graver Water Conditioning Co.*, 216 *W. 14th St., New York* 11.

▸ *CONVENTIONS CALENDAR*—lists national, regional, state meetings and conventions of more than 100 engineering and scientific organizations; includes dates, locations, title of meeting, name of sponsoring organization; available at $4.00 per copy. *Industrial Relations News*, 230 *W. 41st St., New York* 36.

▸ *COPPER TUBING*—catalog contains information for sizing, estimation and specification of tube and pipe requirements for any installation of heating, plumbing, refrigeration, air conditioning. *Bridgeport Brass Co.*, 30 *Grand St., Bridgeport* 2, *Conn.*

it's MARLEY for

World's Most Advanced Line of

WATER COOLING TOWERS

and

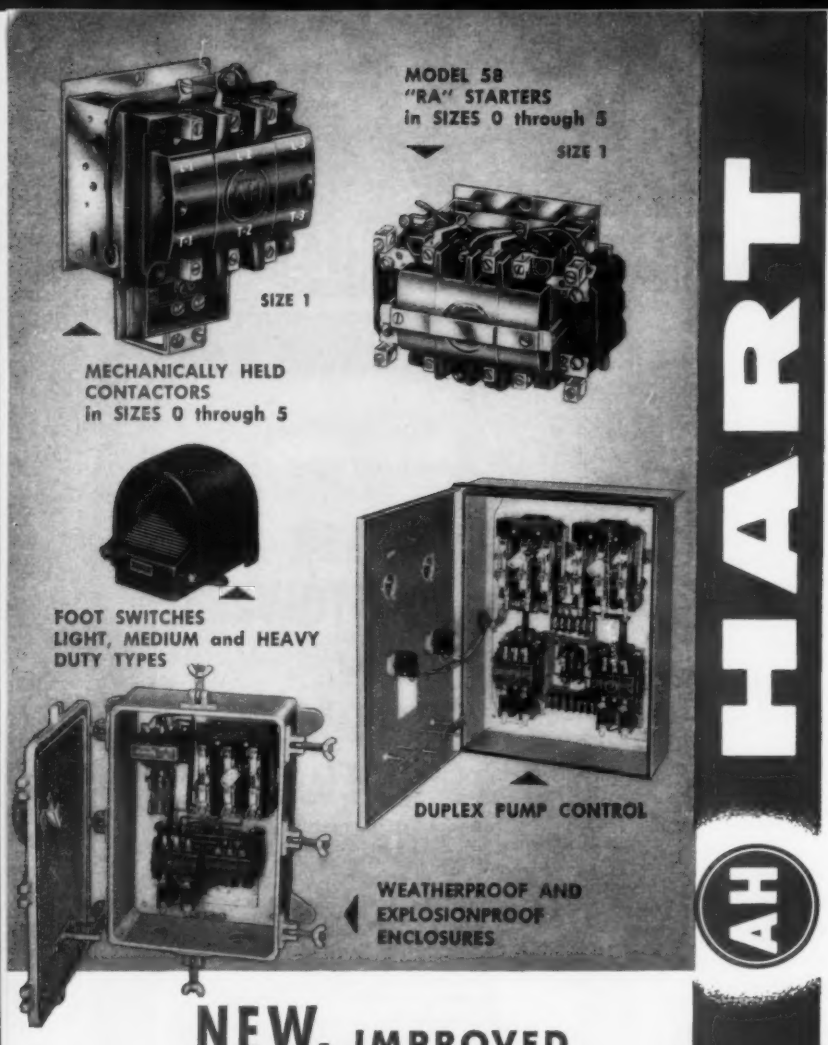
AIR COOLED REFRIGERANT CONDENSERS

Again in 1960, "it's Marley" —for more and better packaged products to handle the cooling requirements for air conditioning, refrigeration, and limited capacity industrial demands. In Marley's complete '60 line (shown on the following pages), you'll find mechanical and natural draft cooling towers and air cooled refrigerant condensers . . . in a wide variety of sizes and styles . . . of structural materials designed for "routine" or ultra-corrosive atmospheres . . . for service indoors or out.

Your nearby Marley distributor makes this "complete coverage" line available on a whenever-and-wherever-needed basis. Also "on your team" is the Marley Company, with its meaningful guarantee of 36-years standing that "every Marley product will be satisfactory to every purchaser."

MARLEY PRODUCTS:

AQUATOWERS® AQUACOOLERS®
SPRATOWERS® WOOD AQUATOWERS®
PERMATOWERS® DRICOOLERS®



NEW, IMPROVED MOTOR CONTROLS INTRODUCED by ARROW-HART for 1960

Pictured above are only a few of the many *NEW, IMPROVED* motor controls offered by Arrow-Hart during 1959.

Arrow-Hart engages in *user* and *customer* research, as well as product research, to determine what advances in motor control design and construction are necessary to supply you with products that *meet present needs* and *anticipate future requirements.*

Long experience . . . look-to-the-future research . . . an unmatched reputation for quality earned through 70 years of service to the electrical industry . . . are sound reasons for relying on ARROW-HART, for specifying—buying—using—motor controls that bear the famous ARROW-HART trade-mark. Write for details on the new products pictured above to The Arrow-Hart & Hegeman Electric Co., Dept. HPAC, 103 Hawthorn St., Hartford 6, Conn.

ARROW AH HART

Quality since 1890

MOTOR CONTROLS · ENCLOSED SWITCHES
APPLIANCE SWITCHES · WIRING DEVICES

ARROW AH HART

RECENT TRADE LITERATURE

Continued

▸ *DECORATIVE GRILLES*—made of aluminum shown in product sheet; available in various patterns for solar shading as well as appearance. *Aluminum Company of America,* 721 *Alcoa Building, Pittsburgh* 19, *Pa.*

▸ *DEMINERALIZER*—designed for process water applications detailed in bulletin "5819"; includes information on use of demineralization process, eliminating variables in water and their effects on product quality control. *Cochrane Corp.,* 17*th St., below Allegheny Ave., Philadelphia* 32, *Pa.*

▸ *DIAMOND BITS*—for drilling concrete described in new brochure; contains typical applications, sizes, specifications. *J. K. Smit & Sons, Inc., Murray Hill, N.J.*

▸ *DRAINAGE FITTINGS*—wall chart and reference guide available; chart illustrates all types and sizes of copper drainage fittings used in different areas. *Grabler Mfg. Co.,* 6565 *Broadway, Cleveland* 5, *O.*

▸ *DRIP-PROOF MOTORS*—with application where adverse conditions of moisture, humidity, dust, oil, chemicals prevail detailed in bulletin "196"; illustrates design features. *Sterling Electric Motors, Inc.,* 5401 *Telegraph Rd., Los Angeles* 22, *Calif.*

▸ *DUCT SILENCERS*—for air conditioning and ventilating systems described in new catalog. *Industrial Acoustics Co., Inc.,* 341 *Jackson Ave., New York* 54.

▸ *DUCT SILENCERS*—to prevent noises from coming through return air vents; bulletins "QM-204-R1" and "QC-205-R2" contain acoustic performance data, dimensions, charts of airflow vs pressure drop. *Industrial Acoustics Co., Inc.,* 341 *Jackson Ave., New York* 54.

RECENT TRADE LITERATURE

Continued

▸ *EVAPORATIVE CONDENSER*—bulletin "PFCF, 531.08" shows construction features of models, also contains selection formulae in which problems and solutions are forwarded; lists mean temperature difference tables and graph shows total heat in moist air. *Drayer-Hanson Div., National-U. S. Radiator Corp.*, 3301 *Medford St., Los Angeles* 63, *Calif.*

▸ *FELT TAPE*—for applications in air conditioning, heating, ventilation industries described in new folder; discusses uses for duct gasketing, anti-vibration gasketing, vent-grill gasketing. *Coast Pro-Seal & Mfg. Co.*, 2235 *Beverly Blvd., Los Angeles* 57, *Calif.*

▸ *FILTER CHART*—for use in selecting filter cloths used in dust and fume collectors; various filtering mediums are classified as to temperature limits, strength, resistance to acid, alkali, abrasion. *Wheelabrator Corp.*, 1321 *S. Byrkit St., Mishawaka, Ind.*

▸ *FUEL OIL PUMP HEATER*—for control of temperature and pressure of heavy oils to insure proper atomization and combustion described in bulletin "15"; includes features, applications, construction. *Walter H. Eagan Co., Inc.*, 2336 *Fairmount Ave., Philadelphia, Pa.*

▸ *GAS CONVERSION BURNER*—catalog sheet available describing unit; burner produces 50,000 to 225,000 Btu. *Barber Mfg. Co.*, 1052 *E. 134th St., Cleveland* 10, *O.*

▸ *GRILLES*—detailed in new booklet including selection guide, performance data, applications. *General Air Products*, 14 *Factory St., Cedar Grove, N.J.*

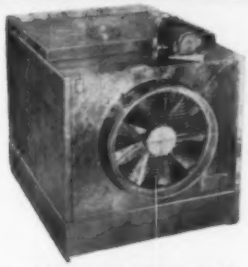
▸ *GRILLES, DIFFUSERS*—for sidewall, ceiling, floor described in bulletin "F-4471-6". *Barber Colman Co.*, 1701 *Rock St., Rockford, Ill.*

▸ *HEATING, COOLING COILS*—manual includes direct selection tables for three types of steam coils, two types of booster coils, two types of water heating coils, three types of water cooling coils, four types of direct expansion coils. *Bohn Aluminum and Brass Corp., Danville, Ill.*

▸ *HEATING COOLING COILS*—catalog "5559" contains information on all water and direct expansion refrigerant coils, includes capacity tables, psychrometric chart, total heat table. *Young Radiator Co.*, 709 *S. Marquette, Racine, Wisc.*

▸ *HOSE FITTINGS*—for industrial applications to plant machinery, mobile equipment, oil field machinery, stationary power plants described in catalog "204"; includes selector chart. *Aeroquip Corp.*, 300 *S. East Ave., Jackson, Mich.*

it's MARLEY for



AQUATOWERS®

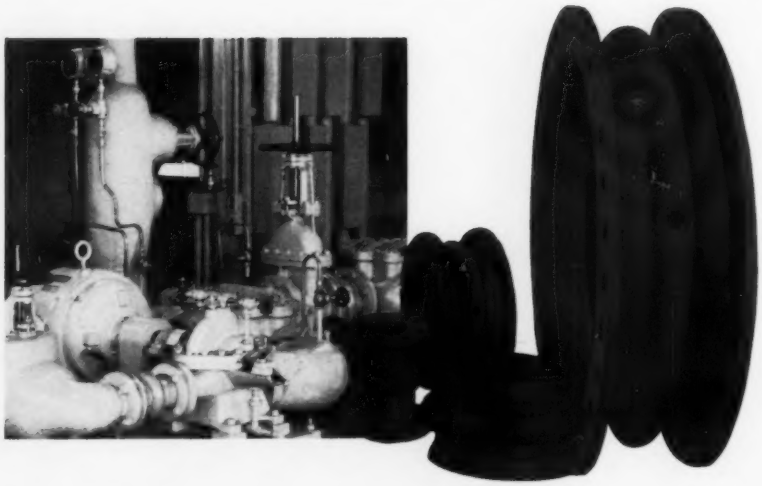
World's best-known steel mechanical draft cooling towers. Heavy-duty mechanical equipment, close-packed filling cube, exclusive diffusion deck and hot dip galvanized finish result in unequalled performance, economy and durability. 14 models from 3 tons up; dual units extend capacities to 120 tons nominal.

AQUACOOLERS®

Indoors or out, in minimum plan area, AquaCoolers can be easily and economically installed. Performance is full-capacity; operation is whisper-quiet and leakproof. Heavy gauge steel casings and basins, as well as centrifugal blowers and scrolls, are hot dip galvanized for extra service life. 10 models available, 5 to 90 tons, nominal.

OTHER MARLEY PRODUCTS:
SPRATOWERS® . . . for natural draft cooling
WOOD AQUATOWERS® and PERMATOWERS® . . . for longest life in corrosive atmospheres
DRICOOLERS® . . . air cooled refrigerant condensers

Save... ON INSTALLATION AND REPLACEMENT COSTS *With* GOODALL *Rubber* EXPANSION JOINTS



Goodall Rubber Expansion Joints are flexible, durable connections for pipe lines and other equipment handling virtually all fluids and gases under pressure and vacuum, to prevent excess stresses due to expansion and contraction; to counteract vibration; and to insulate against undesirable sound. They can also be designed to overcome misalignment.

EASIER TO INSTALL—on new equipment or as replacements. Light in weight, with short face-to-face dimensions. Metal retaining rings quickly aligned and bolted. No gaskets required.

LONGER SERVICE LIFE—no embrittlement or corrosion. High resistance to abrasive wear.

STYLES, SIZES AND PRESSURES TO MEET ALL REQUIREMENTS

Contact Our Nearest Branch, or Write for Catalog

"If it's GOODALL, it MUST be Good!"

Standard of Quality—Since 1870

HOSE · BELTING · FOOTWEAR · CLOTHING
AND OTHER INDUSTRIAL RUBBER PRODUCTS

GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES.
IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

RECENT TRADE LITERATURE

Continued

▸ *HUMIDITY CONTROL*—in hospitals detailed in new data sheet; includes details of procedures, typical applications. *Walton Laboratories, Inc., Irvington* 11, *N.J.*

▸ *INDICATING GAGES*—for pressure and level measurements and pneumatic transmitting or receiving are described and illustrated in product specification "M42-2". *Bailey Meter Co.*, 1050 *Ivanhoe Rd., Cleveland* 10, *O.*

▸ *INDUSTRIAL HAMMERS*—detailed in new catalog; contains sizes of each model including plastic hammers, babbitt hammers, tamper drifts. *Metocraft Alloy & Plastic Co.*, 1039 *Memorial Ave., West Springfield, Mass.*

▸ *INDUSTRIAL THERMOMETERS*—designed for use outdoors on pipe lines described in bulletin "F2"; contains lists of lengths and standard scale ranges. *Precision Thermometer & Instrument Co.*, 1434 *Brandywine St., Philadelphia* 30, *Pa.*

▸ *INSULATED PIPING*—bulletin "PS-1" details features of plasticized casing, pre-fabricated conduit system. *Durant Insulated Pipe Co.*, 325 *Demeter St., East Palo Alto, Calif.*

▸ *LEAK DETECTORS*—with application in vacuum furnaces and metalizers, production or testing of refrigeration units before charging with refrigerant described in bulletin "GET-2935"; includes operation procedures, techniques for locating leaks. *General Electric Co., Schenectady* 5, *N.Y.*

▸ *LEAK STANDARDS*—bulletin "GEA-7024" describes adjustable reference leaks used for calibrating or checking sensitivity of leak detectors; gives details of how users can measure sizes of leak. *General Electric Co., Schenectady* 5, *N.Y.*

RECENT TRADE LITERATURE

Continued

▸ *LEAK TESTING*—of tanks and piping detailed in bulletin "GET-2936"; gives instruction on how to use leak detectors for finding leaks in enclosures that can be pressurized; applications discussed include air conditioning equipment, piping, hydraulic systems, valves. *General Electric Co., Schenectady 5, N.Y.*

▸ *MASONRY DRILLS*—described in new product information folder; includes features of various types of drills and saws. *Truco Masonry Drilling Div., Wheel Trueing Tool Co., 3200 W. Davison, Detroit 38, Mich.*

▸ *MOTOR CONTROLS*—catalog "5900" provides listing of general products; charts for magnetic and manual starters give horsepower, motor speed, heater sizes, heater ampere ratings, enclosure choices. *Furnas Electric Co., 1041 McKee St., Batavia, Ill.*

▸ *OIL BURNER NOZZLE*—catalog gives detailed information on oil nozzle spray characteristics; contains chart showing various standard spray angles. *Monarch Mfg. Works, Inc., 2501 E. Ontario St., Philadelphia 34, Pa.*

▸ *OXYGEN ANALYZER*—detailed in bulletin "1059"; analyzer has accuracy of ±1 to 2 percent of full scale and stability of ±1 percent of full scale. *Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.*

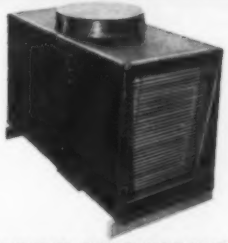
▸ *PACKAGED BOILERS*—catalog "SB-57R" describes two types of boilers featuring integral water cooled furnaces; catalog includes section views, dimensional drawings and mechanical data. *Erie City Iron Works, 735 W. 12th St., Erie, Pa.*

▸ *PLASTIC FILTER*—described in manual "3"; includes methods of isolating, sizing, counting, identifying fine particles in air, gas, liquid streams; techniques for use in air pollution, health physics, industrial hygiene and industrial control. *Gelman Instrument Co., 106 N. Main, Chelsea, Mich.*

▸ *PLASTIC PIPE*—with application in industrial cold potable water applications described in bulletin "102"; brochure contains data on raw materials, extrusion techniques, joining and supporting of pipe applications. *W. R. Grace & Co., Polymer Chemicals Div., 225 Allwood Rd., Clifton, N.J.*

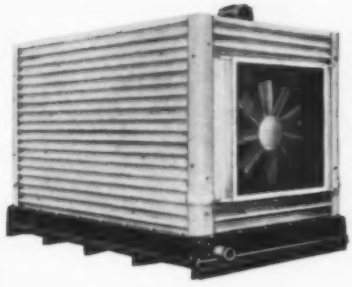
▸ *PRESSURE INDICATING TRANSMITTER*—specification for these indicating transmitters "FS–

it's MARLEY for



PERMATOWERS®

Permatowers offer permanent performance in *any* climate, due to liberal use of inert materials. They also afford a wide latitude in location because air discharge is vertical . . . operation is remarkably quiet . . . and they are virtually immune to corrosion. Performance and simplicity result from famous Double-Flow® design. 11 models in capacities ranging from 5-75 tons, nominal.



WOOD AQUATOWERS®

Forced draft design with vertical air discharge permits installation in confined areas often unsuitable for other towers. Longer service life under the most rigid operating conditions is assured by framework of lifelong redwood, asbestos cement board casing, and hot dip galvanized steel components. 5 models available with nominal capacity of 20-50 tons.

OTHER MARLEY PRODUCTS:
SPRATOWERS® . . . for natural draft cooling
STEEL AQUATOWERS® . . . for mechanical draft cooling
AQUACOOLERS® . . . for service indoors or out
DRICOOLERS® . . . air cooled refrigerant condensers

WHERE CAN A COMPANY OBTAIN INFORMATION ON THE MOST MODERN METHODS OF CONTINUOUS DRYING?

One company recently placed orders for nearly $3,000,000 worth of Surface continuous dryers. More and more chemical and food plants are using the modern services of Surface Combustion engineers.

Purchasers are demanding dryers custom designed to fit the particular problem rather than "Hand-me-downs" to complete the plant automation.

Surface Combustion engineers have many advantages to offer: Kathabar Humidity Conditioning Units; Air heaters instead of individual burners; Laboratory Facilities for testing customers' products; large organization of engineers experienced in mechanical and structural design.

GET FACTS

SURFACE COMBUSTION
A division of Midland Ross Corporation
2384 Dorr Street, Toledo 1, Ohio
Send facts on Kathabar systems for following application:

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name & title .....
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59-4

In Europe: NEDAIRCO, The Hague. In Japan: CHUGAIRO, Osaka.

RECENT TRADE LITERATURE
Continued

301-7" describes transmitter which measures differential pressure ranging from 0 to 20 in. of water to 0 to 400 in. of water, and transmits a proportional 4 to 20 milliamperes d-c signal. *Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves. Philadelphia 44, Pa.*

▸ *PUMP-TANK COMBINATION*—for accurate feeding of chemical solutions and for boiler water treatment described in bulletin "1800.20-1"; two models are shown, one with capacities up to 8.9 gph into discharge pressures up to 1100 psi, other with capacity of 2 gph against 200 psi or 1.4 gph against 300 psi. *B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R.I.*

▸ *RECORDERS, CONTROLS*—detailed in specification "FS-301-8"; all contain integral transistorized power supply that makes possible true two-wire transmission from field mounted devices. *Minneapolis-Honeywell Regulator Co., Wayne & Windrim Ave., Philadelphia 44, Pa.*

▸ *REGISTERS, GRILLES*—catalog describes sidewall, floor, baseboard strip types. *Hart & Cooley Mfg. Co., Holland, Mich.*

▸ *RELIEF VALVE*—which governs discharge pressure of constant speed pumps in oil or water service described in new bulletin; valve is for use at initial pressures to 500 psi and temperatures to 250 F. *Atlas Valve Co., 280 South St., Newark 5, N.J.*

▸ *RUBBER PIPE*—that can be used for conveying abrasive and corrosive chemicals described in new data sheet; complete application data is given as is chart showing I.D. sizes and lengths available. *Mercer Rubber Co., 146 Mercer St., Hamilton Square, N.J.*

▸ *SEAL-LESS PUMPS*—composite

RECENT TRADE LITERATURE

Continued

curve graph available showing ranges of pump and relative head capacity of pump. *Chempump Div., Fostoria Corp., P. O. Box* 35-10, *Huntingdon Valley, Pa.*

▸ *SIDEWALL DIFFUSERS*—discussed in pamphlet which explains features of diffusers, how they function. *Barber-Colman Co.*, 1701 *Rock St., Rockford, Ill.*

▸ *SLUDGE TRAP*—which effectively traps and removes concentrated sulfuric acid sludge described in bulletin "459"; includes design features, operation. *Milton Roy Co.*, 1300 *E. Mermaid Lane, Philadelphia* 18, *Pa.*

▸ *STEAM TRAPS*—to release condensed steam from given steam space detailed in catalog "1001"; includes capacities of various sizes, recommended safety factors for sizing various types of condensate load. *Frank D. Riggio Co., Inc., State Highway* 17, *Rutherford, N.J.*

▸ *STEEL FILTERS*—shown in bulletin "M-212A" including properties of porous stainless steel; full specifications, detailed technical data also contained in brochure. *Micro Metallic Div., A Division of Pall Corp.*, 30 *Sea Cliff Ave., Glen Cove, N. Y.*

▸ *STRIP VENTILATOR*—made of aluminum featured in bulletin "273-L"; includes installation instruction. *Leigh Building Products, Division of Air Control Products, Inc., Coopersville, Mich.*

▸ *SUBMERSIBLE PUMP*—with controlled volume metering against pressure to 1200 psi with accuracy of better than 1 per cent described in bulletin "1153-c". *Milton Roy Co.*, 1300 *E. Mermaid Lane, Philadelphia* 18, *Pa.*

▸ *VALVES*—catalog "60" features 24 page valve selector and over 100 pages of engineering data; complete line of steel, iron, bronze, plastic valves presented along with specifications, illustrations on lubricating devices, boiler mountings, cocks and other products. *Lunkenheimer Co., Waverly & Beekman Sts., Cincinnati* 14, *O.*

▸ *VENTILATOR CONTROLS*—for unit ventilators described in new performance test report; test was recorded at school, report contains complete performance charts, test conditions. *Barber-Colman Co.*, 1701 *Rock St., Rockford, Ill.*

it's MARLEY for

DRICOOLERS®
AIR COOLED
REFRIGERANT CONDENSERS

DriCoolers are of forced draft design that fully utilizes fan efficiency for effective cooling. Air discharge is vertical and unaffected by adverse currents; no hoods or shields are needed. DriCoolers are conservatively rated to insure full capability performance, ruggedly built to insure lasting performance. Mechanical equipment is heavy-duty industrial type; structurals and casings are of materials selected for sturdiness and durability. DriCoolers are designed for all-season service; the DriCooler automatic damper system (optional) makes operation in any climate positive, trouble-free and economical the year 'round. Sound level is exceptionally low. 9 models available.

OTHER MARLEY PRODUCTS:
SPRATOWERS® . . . Natural Draft Towers
AQUATOWERS® and AQUACOOLERS® . . . Steel Cooling Towers for Outdoors or Indoors
PERMATOWERS® and WOOD AQUATOWERS® . . . Cooling Towers that resist corrosion

Costs Less Because It Gives the Most in Service

When selecting unions it will pay you to remember 2 things: (1) Darts can be used over and over again — on location after location (2) On location after location, they give a drop-tight seal. How can you beat this combination for economy . . . at any price?

QUICK FACTS

- Extra wide bronze seats resist pitting and corrosion
- Nut and body of air-refined, high test malleable iron are practically unbreakable
- Heavy shoulders can withstand the toughest wrench abuse
- Each Dart is individually vacuum-tested

DART UNIONS *Products of* **DART UNION COMPANY** PROVIDENCE 5, R.I.

GENERAL SALES AGENT

THE **Fairbanks** COMPANY
393 LAFAYETTE STREET, NEW YORK 3, NEW YORK
BRANCHES: NEW YORK 3
PITTSBURGH 22 • BOSTON 10 • ROME, GEORGIA

AVAILABLE THROUGH YOUR LOCAL DISTRIBUTOR

WE HEAR THAT...

▸ *BACHARACH INDUSTRIAL INSTRUMENT CO.* celebrated its 50th anniversary on December 29 with an open house. The company was founded in 1909 by Herman Bacharach who recognized the need for industrial and field instruments to determine air flow rates and pressures in many types of applications. The company has grown and expanded its operations to an annual level of $2 million for the first time in 1959.

▸ *HARRY E. SEIM,* vice president in charge of *WESTINGHOUSE ELECTRIC CORP.'s STURTEVANT DIV.* has retired after 50 years of service.

▸ *L * A WATER SOFTENER, INC.* and *WATER CONDITIONING, INC.* have merged. The new corporation will be known as *L * A WATER CONDITIONING, INC.*

▸ It has been announced that three *CUTLER-HAMMER, INC.* engineering executives have retired. *P. B. HARWOOD,* senior vice president; *J. L. DEFANDORF,* general supervisor of engineering; and *C. T. EVANS,* consulting engineer have all retired effective Jan. 1.

▸ The second annual *COPPER AND BRASS ACHIEVEMENT AWARD* competition has begun. Nominations should be mailed to the Copper and Brass Assn., 420 Lexington Ave., New York 17 no later than March 31. The winner will receive $1000 and a bronze award.

▸ A new trade organization, the *INDUSTRIAL GAS CLEANING INSTITUTE, INC.* has been formed by manufacturers of gas cleaning equipment.

▸ *CLEAVER-BROOKS CO.* has completed its fifth sales training pro-

important points about joints

- Yarway Gun-Pakt Joints are serviced *in the line under full steam pressure.*
- Costly shutdowns eliminated.
- Maintenance records show 1 manhour per year per joint.
- Fewer expansion joints needed per length of pipeline with Gun-Pakt.

YARWAY GUN-PAKT EXPANSION JOINTS

For new Yarway Expansion Joint Catalog EJ-1916 write YARNALL-WARING CO., 107 Mermaid Lane, Phila. 18, Pa.

go YARWAY with confidence

WE HEAR THAT

Continued

gram. Diplomas have been awarded to 14 members of the company's sales staff.

▸ *AERONCA MFG. CORP.* has announced plans to merge with *BUENSOD-STACEY, INC.* If the merger is approved at meetings of shareholders of both companies later this month, Buensod-Stacey will be operated as a self-contained division of Aeronca.

▸ *PENN BOILER & BURNER MFG. CORP.* has changed the corporate name of the firm to *PEBBCO INDUSTRIES, INC.*

▸ The *ASSOCIATION FOR APPLIED SOLAR ENERGY* has announced that it will become affiliated with Arizona State University.

▸ The *COPPER PRODUCTS DEVELOPMENT ASSN., INC.* has been formed to conduct research and studies.

▸ Establishment of commercial testing laboratories for the testing and calibration of industrial instruments has been announced by *SCHAEVITZ ENGINEERING.*

▸ *HUPP CORP.* has announced the following new shortened names for five of its operating divisions: *GIBSON REFRIGERATOR DIV.; HUPP AVIATION DIV.; PERFECTION DIV.; TYPHOON AIR CONDITIONING DIV.*

▸ *WILSON BROS.* has acquired all outstanding stock in *LAWSON MFG. CO.*

▸ *E. J. SCHWANHAUSSER,* vice chairman of *WORTHINGTON CORP.* has retired. He will continue as a director.

(*Continued on page* 176)

down went heating costs by 35%

with Dravo *Counterflo* Heaters

Learn how one company switched to Dravo *Counterflo* warm air space heaters and reduced their heating bill by more than $6,000 per year. Plant is warmer, too, and 3,400 square feet of valuable space were made available for manufacturing.

Use the coupon for full details.

DRAVO CORPORATION
Department H-11, Room M-214
Pittsburgh 25, Pa.

Send me free copy of 12-page report on warm air space heating and the facts on the company mentioned above.

Name_____
Position_____
Company_____
Address_____
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City_____
Zone____ State_____

DRAVO CORPORATION

New RIDGID® No. 141 Geared Threader

For 2½", 3", 3½", 4" Pipe and Conduit

Save Time...Cut Costs on all large threading jobs!

1. Only 1 Set of High Speed Dies threads 2½", 3", 3½" and 4" pipe and conduit. No extra die sets to change or lose! Die size selector plate sets quickly and locks at desired size. Easy adjustment for tapered, straight, over or under size threads.

2. Jam-Proof for safe threading by power or hand. Drive pinion kicks out automatically. Die head *Can't Jam* . . . avoids costly repairs and delay.

3. New Fast-Action, Cam-Type Workholder sets to size by quick turn of collar. Set screw holds work centered for perfect threads every time . . . adjustable for drip threads.

Your Supply House has them!
Order your new RIDGID No. 141 Threader today!

RIDGID
The Ridge Tool Company • Elyria, Ohio, U.S.A.

WHO'S WHAT . . .

▸ *BALTIMORE AIRCOIL CO., INC.*—John H. Morris, industrial engineer.

▸ *VILTER MFG. CO.*—A. A. Silverman, president, general manager, treasurer; E. M. Johnson, assistant treasurer and assistant secretary.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—Dean B. Randall, director of advertising; Richard Crouser, advertising and sales promotion manager, residential div.; Robert Ruff, advertising and sales promotion manager, commercial and international divs.

▸ *LENNOX INDUSTRIES, INC.*—Robert A. Pierce, general manager; F. Gordon Lenzi, sales manager.

▸ *SQUARE D CO.*—T. R. Oakes, vice president and secretary; Henry Morgan, vice president and director.

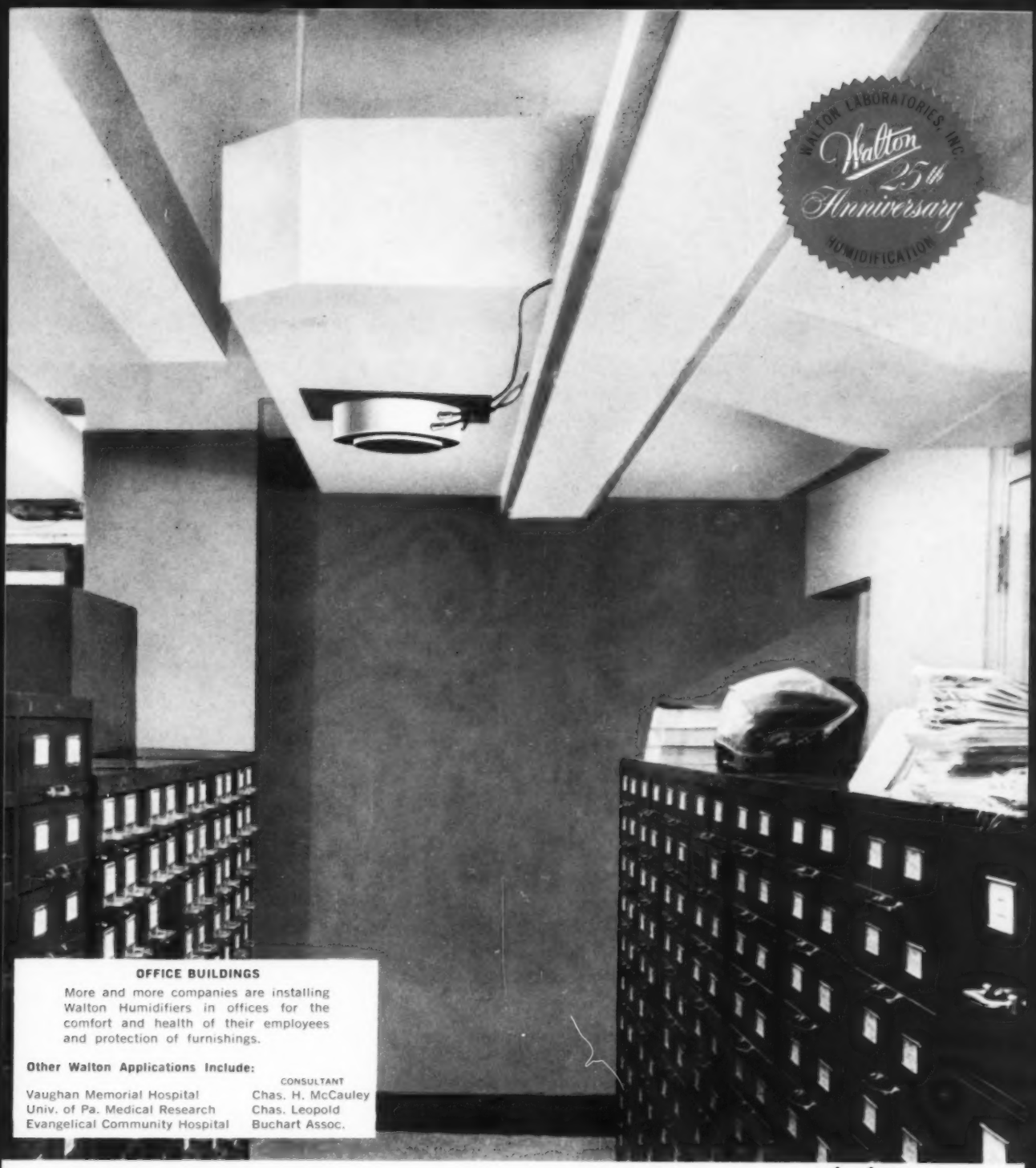
▸ *PENNSALT CHEMICALS CORP.*—Albert H. Clem, vice president of marketing; George R. Lawson, general manager of chemical specialties div.

▸ *RUBEROID CO.*—E. J. O'Leary, president and chairman elected director of Cumberland Chemical Corp.; Joseph G. Hall, general sales manager, Rhys L. Stanger, assistant general sales manager.

▸ *OLIN MATHIESON CHEMICAL CORP.*—Joseph F. Krepley extrusion product manager, Olin Aluminum Metals Div.; Richard E. Clay, transportation sales manager, Olin Aluminum Metals Div.

▸ *BLACK & DECKER MFG. CO.*—William S. Brucker, engineering manager of Master Power Corp. subsidiary; John L. Bennett, product development manager; Robert H. Riley, Jr., technical services manager, engineering dept.; Samuel H. Kohler, product development supervisor, engineering dept.

▸ *NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSN.*—president: Harry C. Gurney, general sales manager, Janitrol Heating and Air Conditioning Div., Midland-Ross Corp.; first vice president: Don Winegardner, vice president, heating div., Majestic Co., Inc.; second vice president, Harold P. Mueller, Jr., executive vice president, Muller Climatrol Div., Worthington Corp.; James M. Martin, secretary-treasurer.



OFFICE BUILDINGS

More and more companies are installing Walton Humidifiers in offices for the comfort and health of their employees and protection of furnishings.

Other Walton Applications Include:

	CONSULTANT
Vaughan Memorial Hospital	Chas. H. McCauley
Univ. of Pa. Medical Research	Chas. Leopold
Evangelical Community Hospital	Buchart Assoc.

They Wanted Real Humidification . . . they used Walton

KEEP ABREAST OF HUMIDIFICATION DEVELOPMENTS. Registered architects need only send their name and address to receive Walton's all-inclusive Architects and Engineers File plus the monthly Markets and Methods reports.

A COMPLETE LINE OF HUMIDIFIERS

. . . For Any Heating, Ventilating or Cooling System
. . . For Existing Systems or Ones Being Planned
. . . For Systems With or Without Ducts
. . . For Special Engineering Projects

All featuring Walton's patented centrifugal atomizer for positive, controlled humidification.

Walton ATOMIZING HUMIDIFIERS

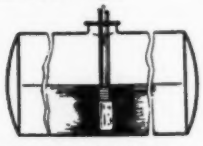
Walton Laboratories, Inc. • Irvington 11, New Jersey
Chicago Office: 548 W. Washington Blvd.

REMPE
Heat Transfer Equipment

"HOT SPOT" PREHEATER

FOR HEAVY OILS AND LIQUIDS IN BULK STORAGE

Preheats fuel oils and other liquids to proper flow temperature before entering the suction line.



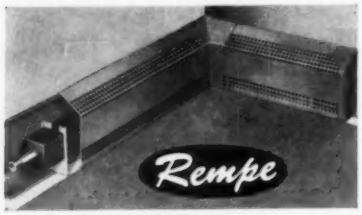
Heats with Steam or Hot Water

The Rempe "Hot-Spot" does an efficient preheating job . . . releases more BTU'S from fuel oils. Special flow accumulator causes liquids to pass over heated coils. Takes the load off the suction pump.

All steel shell and coil assembly—14" or 16" shell diameters—Connections furnished correct length for any tank diam.

MODERN • HIGH CAPACITY

BASEBOARD CONVECTORS



For Residential or Commercial Appications

Distributes heat evenly along cool walls and under windows. Replaces old style radiators—enlarges working space. Only 3" deep and 8" high—comes in 10' lengths. Standard design uses 1" OD copper tube —also available with two finned elements. This is the highest capacity convector for its cross section on the market. Easy to install.

WRITE FOR LITERATURE AND PRICES

Engineering Data Book

Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY

342 N. Sacramento Blvd. • Chicago 12, Ill.

WHO'S WHAT

Continued

▸ *NATIONAL NOISE ABATEMENT COUNCIL*—president: E. G. Dyett, Jr., Instrument Div., H. H. Scott, Inc.

▸ *RIDGE TOOL CO.*—William L. Parcell, executive vice president; R. D. Fye, sales manager; H. L. Palmer, advertising manager and assistant sales manager; Herman Weible, plant manager, Clarence T. Heintz, production superintendent.

▸ *WARREN WEBSTER & CO., INC.*—Robert W. Butler, vice president of operations.

▸ *DUNHAM-BUSH, INC.*—Joseph Jacobs, Jr., advertising manager; John L. Roth, product manager, air conditioning.

▸ *OHIO BRASS CO.*—O. L. Allanson, factory manager, Barberton plant; J. F. Miefert, factory manager, Mansfield plant.

▸ *AEROQUIP CORP.*—M. Lloyd Jones, Jr., general manager, general logistics div.; Victor Emery, general sales manager, industrial div.

▸ *AMERICAN-STANDARD PLUMBING & HEATING DIV.*—William H. Baker, Jr., manager, industry relations.

▸ *SOUTHWEST INSULATION CONTRACTORS ASSN.*—president: E. J. Stern; vice president: Roy Coffer; secretary-treasurer: Frank M. Taylor; directors: Granville Drowns; N. W. Railey; M. G. Steinmeyer; H. M. Aber; Homer C. Porter; W. J. Childress; M. R. McCarty; Ray W. Thomas; B. J. Barnhart.

▸ *GENERAL CONTROLS CO.*—John R. Curran, divisional vice president and general manager, Hammel-Dahl/Foster Engineering Div.

▸ *WITCO. CHEMICAL CO., INC.*—Michael D. MacBurney, general manager, Pioneer Products Div.

▸ *NATIONAL ELECTRICAL MFR. ASSN.*—chairman of Insulating Materials Div.: E. R. Perry, president, National Vulcanized Fibre Co.

▸ *COMBUSTION ENGINEERING, INC.*—Robert A. Niemi, director of manufacturing.

(*Continued on page* 178)

NOTE for SPECIFICATION and BUYING INFORMATION

It's a valuable tool — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the blowers, traps, boilers, fittings, specialties of all kinds, etc, you need — and where they're located. They're identified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference. Keep it handy . . . it's a time saver.

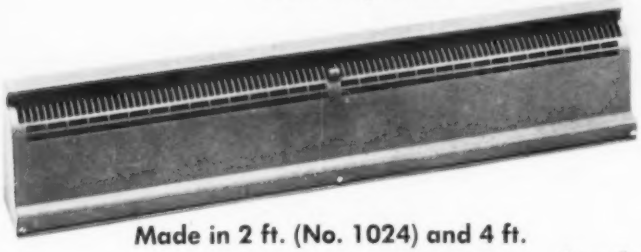
USE YOUR COMPLETE, UP-TO-DATE JANUARY 1960 DIRECTORY NUMBER

Supreme Quality and Character

PREDOMINATE in the SUPERBLY ENGINEERED PRODUCTION of the WORLD'S FINEST REGISTERS and GRILLES

Buy U.S.— Get the BEST— COSTS NO MORE

New Improved No. 1000 Series U.S. BASE DIFFUSER



Made in 2 ft. (No. 1024) and 4 ft. (No. 1048) Sizes

More Free Area
More Beautiful Than Ever
More Powerful Than Others
Has More of Everything
Do not Miss the New No. 1000 Line—
U.S. Base Diffusers

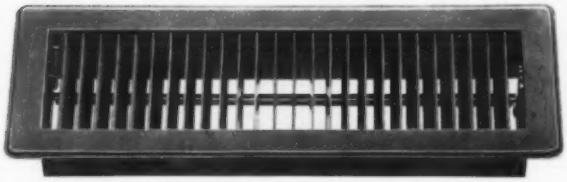
MAXIMUM FREE AREA

No. 1018 U.S. Base Diffuser—Practical for Low-Cost ECONOMY Jobs where Brevity of Length and Capacity is more important—and where Diffusion is more Essential than the SPREAD Distribution of LONGER LENGTH.

Another WINNER for PROJECT WORK

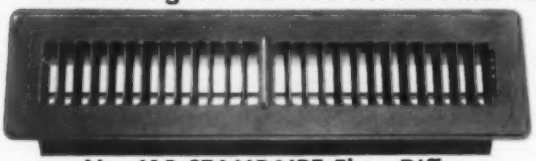
Made in No. 1018 SIZE ONLY —(18″ Length)

We Now Present the New No. 410 U.S. DIFFUSER FLOOR REGISTERS

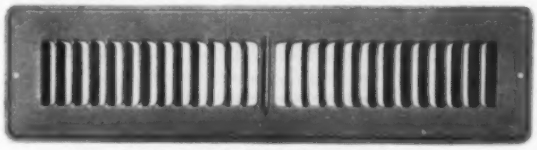


WIDER MARGINS to Cover CRACKAGE due to over-sized Floor Openings. GRADUATED CURVED GRID-BARS to Permit Wide Perfect Even Air Diffusion. Sector-LEVER OPERATOR — Positive Easy Control. SET-SCREW LOCK for System Balancing at the Register.

Presenting the No. 413 STAMPAIRE Floor Diffusers and No. 313 STAMPAIRE Toe Plate



No. 413 STAMPAIRE Floor Diffuser
with Stamped Face for Competitive Project Systems where QUALITY is also Required, which High Quality is still maintained in the No. 413 StampAire. Made in six sizes.



No. 313 STAMPAIRE Toe Plate
for use in Kitchens, Bathrooms, Closets, and Stair Risers where space is limited and Small Amount of Air is Required.

INSIST UPON U.S. and GET THE BEST

UNITED STATES REGISTER COMPANY

BATTLE CREEK, MICHIGAN
MINNEAPOLIS • KANSAS CITY • ALBANY

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide
Changes that Danger Zone to a
SAFETY ZONE

The distance between the floor of your plant and your overhead valves is a DANGER ZONE when piled up boxes or even ladders are used to reach the valves.

Turn it into a SAFETY ZONE — equip your overhead valves with Babbitt Adjustable Sprocket Rims with Chain Guides.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. If your supplier does not carry them, contact us direct.

Babbitt 1689

STEAM SPECIALTY CO.

8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

WE HEAR THAT

Continued from page 171

▸ A wholly-owned subsidiary, *MANNING, MAXWELL & MOORE, S. A.* has been organized in Fribourg, Switzerland, by *MANNING, MAXWELL & MOORE, INC.*

▸ *CHASE BRASS & COPPER CO., INC.* has organized a product development dept. to aid in giving technical assistance to customers.

▸ *ELEKTRO MFG. CO.* has taken over the complete facilities of *KILLEEN AND SON PRODUCTION ENGINEERING CO.*

▸ *PENNSALT CHEMICALS CORP.* has purchased a 50 acre site in King of Prussia Park, Pa. for construction of a technical center which will represent an ultimate investment of $5 million.

▸ Plans for establishment of an oil burner manufacturing plant in continental Europe and for the inauguration of heavy oil burner production in the U.S. were discussed jointly by *NU-WAY HEATING PLANTS, LTD.* and *NU-WAY CORP.*

▸ *PENNSALT CHEMICALS CORP.* has announced plans to build a new blending, packaging, and warehousing plant in Atlanta, Ga.

▸ *JOSEPH T. RYERSON & SON, INC.* has announced that it has added Reynolds aluminum to its steel service center stocks at Seattle, Wash.

▸ Consolidation of Humphrey gas heaters into the production of its line of gas equipment has been achieved by *ARKLA AIR CONDITIONING CORP.*

FREE – The Full Story Of Economical Infra-Red Comfort Heating

Industrial and commercial buildings of all kinds are now being heated by economical gas-fired overhead PANELBLOCS — the unit that "Heats Like the Sun." Panelbloc offers an entirely new heating concept. Unlike traditional heating equipment that heats the air, Panelbloc heats objects and people.

Panelbloc is low in first cost, installation is economical, since no electrical connections are needed. No fans or motors are needed for these unique heaters.

We have a complete literature file on this equipment, and you are welcome to any items you'd like to have.

Gentlemen: Please send me literature checked:

☐ **PANELBLOC CATALOG**
This pictures and describes the equipment, gives dimensions and technical data: operating principle.

☐ **PANELBLOC PHOTO ALBUM**
This lavishly illustrated brochure shows actual installations in a wide range of commercial and industrial plants.

☐ **PANELBLOC CASE HISTORIES**
Tell us what your business is, and we'll send you a case history describing Panelbloc in a business similar to your own.

☐ **TRADE PAPER REPRINTS**
Learn what the experts say about Panelbloc.

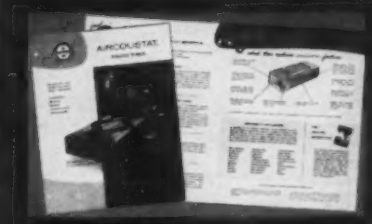
JUST CLIP THIS SHEET TO YOUR LETTERHEAD AND MAIL TO US.

PANELBLOC DIVISION
The Bettcher Mfg. Corp.
3106 West 61 St., Cleveland, Ohio

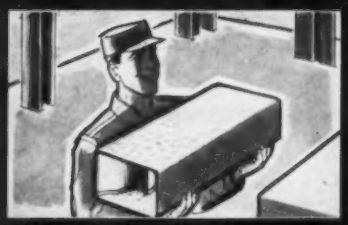
OVERHEAD PANELBLOC

7 ways AIRCOUSTAT®
can save you time and money

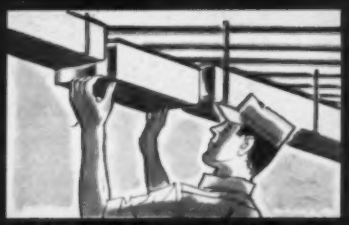
Sound Traps . . . with Guaranteed Results



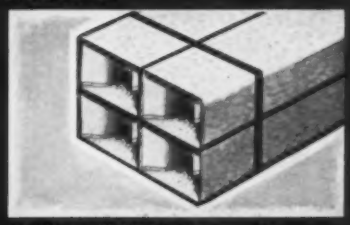
1) Easy to select—Just 3 steps to specify proper model. Save time, avoid errors.



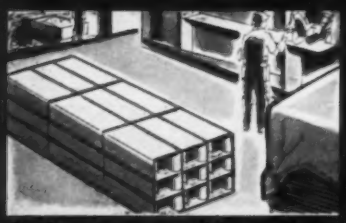
2) Easy to handle—No riggers or special equipment needed. Large units composed at job site.



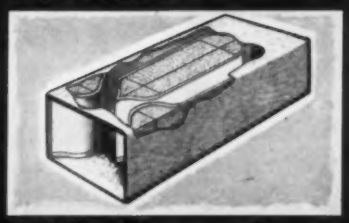
3) Easy to install—Units are installed the same as ductwork. Units have 2" extensions.



4) Fits all duct sizes—Big units are easily assembled from small Aircoustat units.



5) No storage problem—Units are delivered right to the job site, ready to install.



6) No maintenance—Units are fire-resistant, dust-proof and built to last a lifetime.

7) Guaranteed results—Solves every noise reduction problem. Units are completely reliable.

Pre-engineered by Koppers to eliminate guesswork, unnecessary calculations and difficult installations, AIRCOUSTAT Sound Traps guarantee trouble-free silencing of all duct-transmitted noise . . . at a savings in time and money to you.

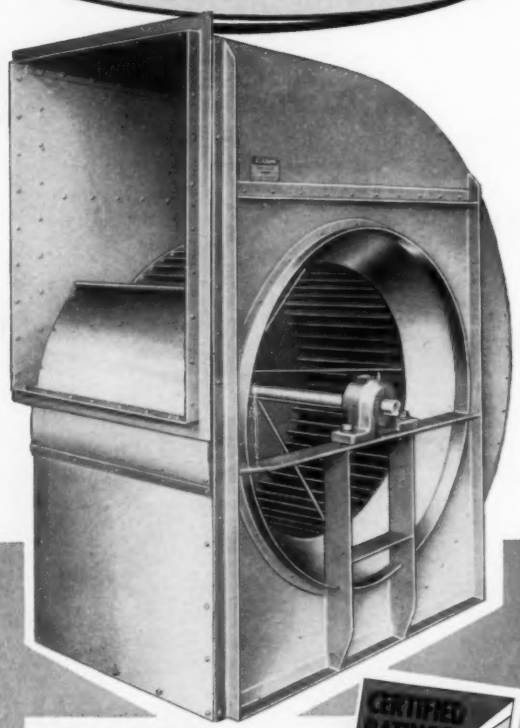
AIRCOUSTAT selection is quick, simple and reliable. A choice of over 60 stock models, fabricated in 6 lengths, solves every noise reduction problem. AIRCOUSTAT is built to give a lifetime of maintenance-free service.

Write today for your copy of the AIRCOUSTAT Selection Manual, a quick guide to the right unit or combination of AIRCOUSTAT units to eliminate duct-transmitted noise in all air handling systems. Write KOPPERS COMPANY, INC., Sound Control Department, 3302 Scott Street, Baltimore 3, Maryland.

KOPPERS®

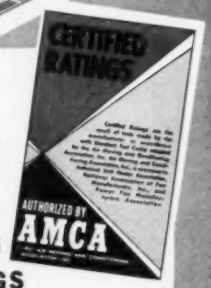
SOUND CONTROL
METAL PRODUCTS DIVISION
Engineered **Products Sold with** ***Service***

Aladdin
AIR HANDLING EQUIPMENT



FANS with built-in quality

- EFFICIENT
- QUIET OPERATING
- CERTIFIED RATINGS



ALADDIN Series 94 Type FC Fans are available in 22 sizes both single and double width. These fans have been designed for the lowest rotational speeds consistant with high efficiency over the widest possible range of operating conditions.

Each fan is ruggedly built... fully equal to the job for which it is designed, and is backed by thirty-five years of know-how in manufacturing all types of air handling equipment.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

A3

WHO'S WHAT

Continued from page 174.

▸ *KEASBEY & MATTISON CO.*—Edgar F. Ott, Jr., sales engineer; Norman L. Barr, vice president, sales.

▸ *YORK DIV., BORG-WARNER CORP.*—J. V. Clippinger, manager, parts and accessory sales; Albert J. Krause, merchandise manager, commercial air conditioning; W. E. Landmesser, general sales manager for packaged products; F. C. Wood, manager air conditioning sales.

▸ *TEXAS INSTRUMENTS, INC.*—L. E. Blackwell, product sales engineer.

▸ *FOSTER WHEELER CORP.*—W. L. Martwick, chairman of board; John E. Kenney, president and chief executive officer; Clark P. Lattin, Jr., director.

▸ *LIQUIDOMETER CORP.*—Raymond T. Zwack, manager of industrial products.

▸ *CRANE CO.*—Robert E. Catlett, manager of chemical industry sales; Wesley A. Songer, president and chief administrative officer.

▸ *GENERAL MOTORS CORP.*—Vincent J. Castrop, director of industrial hygiene dept.

▸ *BELL & GOSSETT CO.*—Louis S. Oosten, vice president in charge of engineering.

▸ *COMBUSTION ENGINEERING, INC.*—Herbert M. Lowenstein and John L. Menson, vice presidents.

▸ *BABCOCK & WILCOX CO.*—Walther H. Feldmann, to board of directors.

▸ *PITTSBURGH PLATE GLASS CO.*—Paul A. Ketchum, vice president in charge of glass sales, merchandising div.; Howard J. Mather, vice president of industrial sales for paint div.; Paul Luscher, technical assistant to general manager.

▸ *ARMCO STEEL CORP.*—Wallace B. Quail, vice president in charge of distribution; Murray B. Wilson, sales vice president.

▸ *NEPTUNE METER CO.*—Wentworth Smith, marketing vice president; John J. Carroll, general manager, liquid meter div.

WHO'S WHAT

Continued

▸ *YOUNG RADIATOR CO.*—Robert T. Trecek, advertising assistant.

▸ *BORG-WARNER CORP.*—William F. Martin, director of manufacturing services.

▸ *AMERICAN CHAIN & CABLE CO., INC.*,—Frederick M. Jackson, sales manager, R-P&C Div.

▸ *BETTER HEATING-COOLING COUNCIL*—president: R. S. Doherty, vice president, A. W. Cash Valve Mfg. Corp.; vice president: Carroll M. Baumgardner, vice president, National-U.S. Radiator Corp., new directors: Milton M. Brooks, Slant/Fin Radiator Corp.; Henry M. Gibb, Pacific Steel Boiler Div., National-U.S. Radiator Corp.; Chester H. Kirk, American Tube Products, Inc.; Ralph A. Patterson, Bell & Gossett Co.; Robert W. Williams, American-Standard; Irvin L. Rechkemmer, National Assn. of Plumbing Contractors; John L. Robertson, Central Supply Assn.

▸ *REMINGTON CORP.*—Carl L. Tucker, chief engineer.

▸ *VIKING AIR PRODUCTS, DIV. NATIONAL-U.S. RADIATOR CORP.*—John M. Furin, assistant sales manager.

▸ *YORK DIV., BORG-WARNER CORP.*—regional managers: E. J. Berlet, north Atlantic; T. Y. Davis, middle Atlantic; W. W. Salmond, southeast; R. A. Johnson, east central; R. E. Miller, central; G. C. Briley, southwest; C. P. Strickland, Pacific.

▸ *NIAGARA BLOWER CO.*—Duane R. Laminman, Virginia, North Carolina territory.

▸ *PITTSBURGH CORNING CORP.*—Julian H. Byrd, sales representative, Philadelphia.

▸ *INLAND STEEL PRODUCTS CO.*—Ben F. Kracht, Kansas City branch manager; Glenn R. Detrie, St. Louis branch manager.

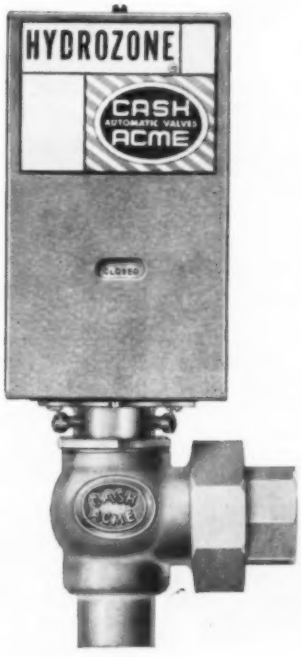
▸ *BOHN ALUMINUM & BRASS CORP.*—Power Equipment Co., sales representative for Virginia.

• A NEW ZONE CONTROL VALVE THAT DARES TO BE BEST •

Hydrozone® outlasts... out-performs other zone valves

12 to 1!

The weight alone tells you that this is a zone control valve that's designed to last a lifetime! Heavier, sturdier . . . Hydrozone® Motorized Valves provide rugged, consistent performance up to twelve times longer than other zone valves.



COMPACT, UNITIZED CONSTRUCTION • OPERATES IN ANY POSITION • MANUAL OPEN-CLOSE ADJUSTMENT • RUGGED ANGLE VALVE DESIGN • TIGHT-CLOSING SILICONE VALVE SEAT • QUIET OPERATION • LEAK-PROOF SEAL CONSTRUCTION (PAT. PENDING) • DUST-PROOF HEAVY ALUMINUM MOTOR CASE • SELF-ALIGNING, LIFTING STAINLESS STEEL VALVE STEM • LIFE-TIME LUBRICATION • IN-BUILT UNION CONNECTION SUPPLIED

Another quality product of
INDUSTRY'S WIDE, WIDE LINE

A. W. CASH VALVE MFG. CORP.
666 E. Wabash Ave.
Decatur, Illinois

CASH AUTOMATIC VALVES ACME

Shuford's
SHURTAPE®
MP-26
METALLIZED
PAPER INSULATION TAPE

SHURTAPE MP-26, silver-colored, is specifically designed to hold insulation to duct work and to seal joints of metal or fibre duct.

It is inexpensive, easy to apply, and provides an inconspicuous, *positive* seal resulting in a neat, finished appearance.

The flat kraft-paper backing is metallized, rubber impregnated, and contains flame inhibiting chemicals to retard inflammability. These features, combined with a low moisture vapor transfer rate, excellent resistance to water and abrasion, resistance to solvents and oils, make Shuford's SHURTAPE MP-26 an ideal multi-purpose tape for use in heating and air conditioning installations.

Write for complete information to

CLOTHES LINES • TWINES
PRESSURE-SENSITIVE PAPER TAPES
SASH CORDS • WEATHER STRIPPING
COTTON & RAYON YARNS • EXTRUDED PLASTICS

World's Largest Manufacturer of Cotton Cordage

4513

MEETINGS & CONVENTIONS

FEB. 8-11—*12th Short Course on Hydronic Heating and Cooling Systems including Business Management and Promotion.* Conducted by Dept. of Mechanical Engineering and Bureau of Business Management, University of Illinois in cooperation with Institute of Boiler and Radiator Manufacturers. Information: Supervisor of Engineering Extension, 116-D Illini Hall, University of Illinois, Urbana, Ill.

FEB. 15-18—*Industrial Ventilation Conference.* Kellogg Center, Michigan State University, East Lansing, Mich. Co-sponsored by the College of Engineering and the Division of Occupational Health of the Michigan Department of Health. Information: Michigan State University, Kellogg Center for Continuing Education, East Lansing, Mich.

MARCH 21-24—*2nd Annual Industrial Ventilation Conference.* North Carolina State School of Engineering, Raleigh, N.C. Conducted by Dept. of Mechanical Engineering of School of Engineering and College Extension Division; sponsored by Occupational Health Section of North Carolina State Board of Health. Information: College Extension Div., P.O. Box 5125, State College, Raleigh, N.C.

MARCH 29-31—*22nd Annual American Power Conference.* Hotel Sherman, Chicago. Information: Conference Director, R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

APRIL 4-7—1960 *Nuclear Congress and International Atomic Exposition.* New York Coliseum, New York City. Information: International Atomic Exposition, 117 S. 17th St., Philadelphia 3, Pa.

APRIL 4-7—*Oil Heat Institute of America, Convention and Exposition.* Convention: Park-Sheraton Hotel, New York, Exposition: Coliseum, New York. Information: Oil Heat Institute of America, Inc., 500 5th Ave., New York 36.

APRIL 5-7—1960 *Spring Conferences of the Building Research Institute.* Statler-Hilton Hotel, New York City. Information: Milton C. Coon, Jr., BRI executive director, 2101 Constitution Ave., N.W., Washington 25, D.C.

APRIL 25-29—*American Welding Society, annual meeting and exposition.* Los Angeles. Information: American Welding Society, 33 W. 39th St., New York 18.

APRIL 27-30—*Western Air Conditioning, Heating Ventilating and Refrigeration Exhibit and Conference.* Shrine Exposition Hall, Los Angeles. Information: Western Air Conditioning Industries Association, 3443 S. Hill St., Los Angeles 7.

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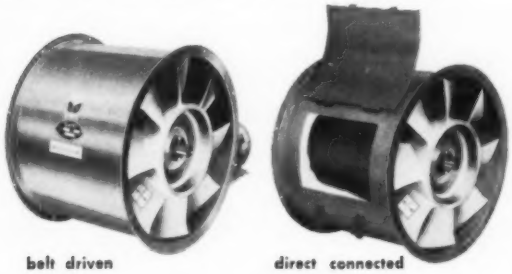

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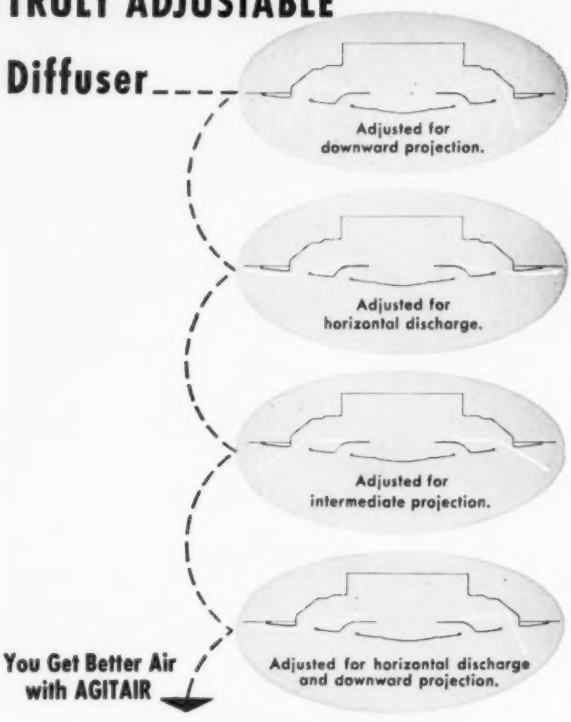
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MAY 9-12—*Instrument Society of America, 2nd Instrument-Automation Conference and Exhibit.* Civic Auditorium and Brooks Hall, San Francisco, Calif. Information: Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

JUNE 5-9—*9th National Plastics Exposition and SPI National Conference,* sponsored by the Society of Plastics Industry, Inc. Exposition: Coliseum, New York City, Conference: Commodore Hotel, New York City. Information: The Society of Plastics Industry, Inc., 250 Park Ave., New York 17.

JUNE 6-9—*National District Heating Association 51st Annual Meeting.* Grove Park Inn, Asheville, N.C. Information: National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.

JULY 25-29—*13th International Congress on Occupational Health.* Waldorf-Astoria Hotel, New York. Information: Dr. Leo Wade, 15 W. 51st St., New York.

NOV. 28-*DEC.* 2—*24th National Exposition of Power and Mechanical Engineering.* Under auspices of the American Society of Mechanical Engineers. New York Coliseum. Information: International Exposition Co., Inc. 480 Lexington Ave., New York 17.

OCT 12-15—*Cast Bronze Bearing Institute and Non-Ferrous Founders' Society annual meetings.* Grove Park Inn, Asheville, N.C. Information: Non-Ferrous Founders' Society, 1604 Chicago Ave., Evanston, Ill.

NEW BOOKS & REPORTS...

Modern Air Conditioning Practice—by Norman C. Harris. McGraw-Hill Book Co., 330 W. 42nd St., New York 36. $6.75.

Welding Nuclear Power Piping. 20 pp. American Welding Society, 33 W. 39th St., New York 18. $1.50.

Adsorption Equipment, AD 1-1959. National Electrical Manufacturers Assn., 155 E. 44th St., New York 17. 30c.

Titanium Welding. 24 pp. American Welding Society, 33 W. 39th St., New York 18. $1.50.

Refrigeration Controls, DC 7-1959. National Electrical Manufacturers Assn., 155 E. 44th St., New York 17. 30c.

Installation of Vertical Hydraulic-Turbine-Driven Generators, LG 3-1959. National Electrical Manufacturers Assn., 155 E. 44th St., New York 17. $2.00.

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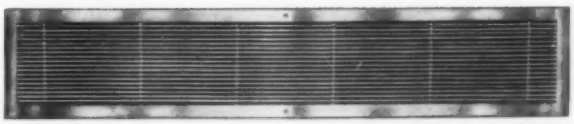

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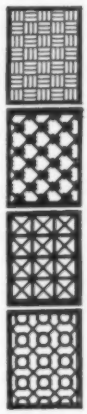

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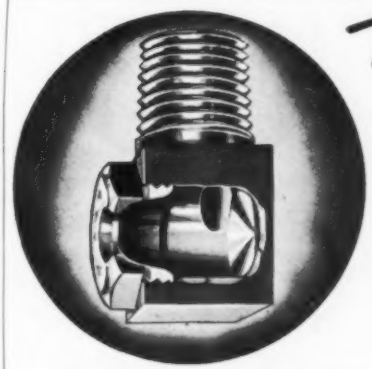

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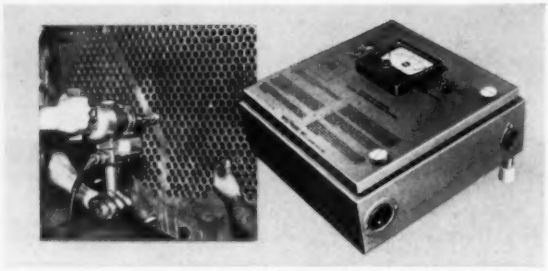

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Obituaries

Clarence E. Pullum

CLARENCE E. PULLUM, 66, passed away January 8 after a long illness. Mr. Pullum was executive vice president-treasurer of Bell & Gossett Co. He was also chairman of the board of the Marble Companies, and was a director of the First National Bank, Morton Grove, Ill., as well as past president of the Skokie Valley Industrial Association.

Mr. Pullum joined Bell & Gossett in 1918, became vice president in 1933, and executive vice president in 1954.

Harry R. Clarage

HARRY R. CLARAGE, 70, president of the Clarge Fan Co., passed away on December 26 of a cerebral hemmorhage. Since 1945, Mr. Clarage had been president of the company.

The company was founded in 1872 by Thomas Clarage, his grandfather, who organized it as the Bird and Clarage Foundry. Mr. Clarage's father pioneered the company's development as a fan manufacturer in 1913.

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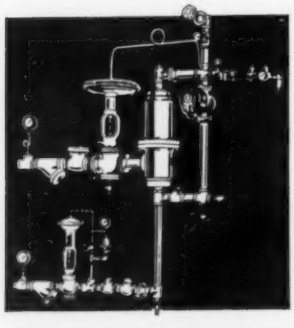

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Continental Air Filters, Inc.
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MAINTENANCE ENGINEER — Pharmaceutical manufacturer has need for graduate mechanical engineer, under 35 years of age, to plan and administer the operation and maintenance of temperature and humidity control equipment and water systems; as well as, establish and maintain preventive maintenance schedules, issue work instructions, prepare budgets and investigate new materials. Some experience beneficial. Salary open, depending on qualifications. Forward complete resume to Chief, Personnel Requirements Department, ELI LILLY AND COMPANY, Indianapolis 6, Indiana.

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NOW Poly-Mag 80!

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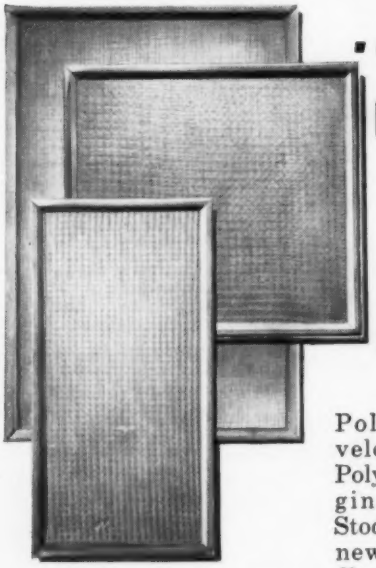

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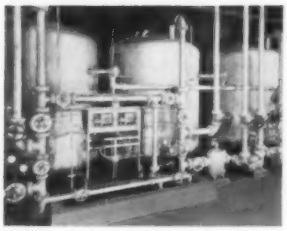
Bruner equipment supplies soft water for Michigan State University's Kellogg Center, including the new $500,000 wing (above). Consulting Engineers for the Center: Kenneth Phelps, Ann Arbor; Gene Stender, Battle Creek. Architect: L. J. Sarvis, Battle Creek. Plumbing Contractors: R. L. Spitzley Co., Detroit; J. A. Dart Co., Lansing; United Piping & Erecting Co., Lansing.



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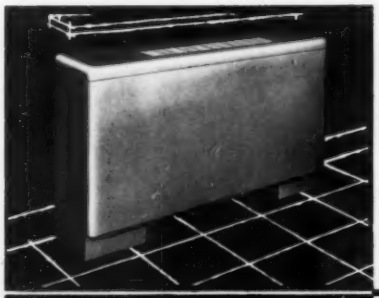

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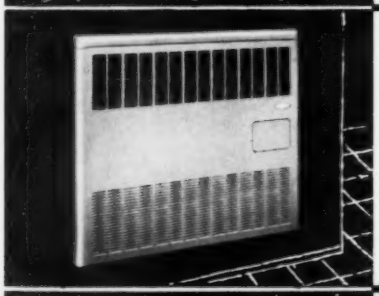

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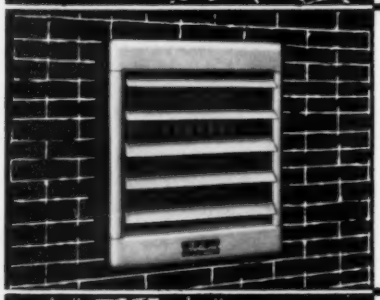

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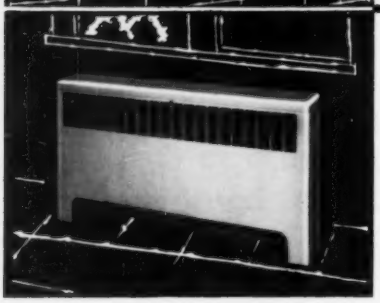

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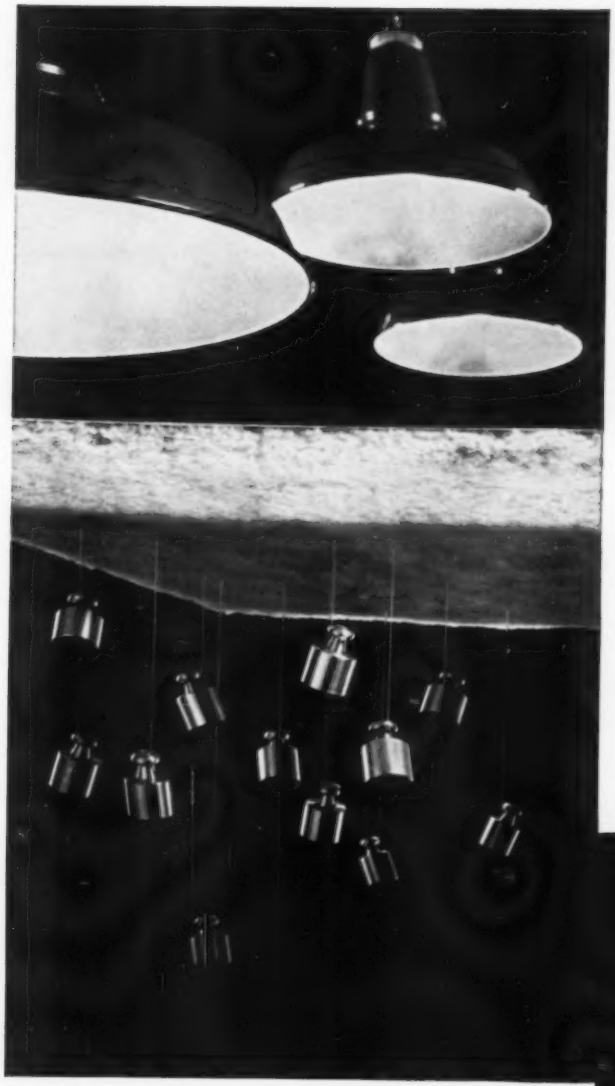
3M Brand Adhesives and Sealers answer these insulation needs...



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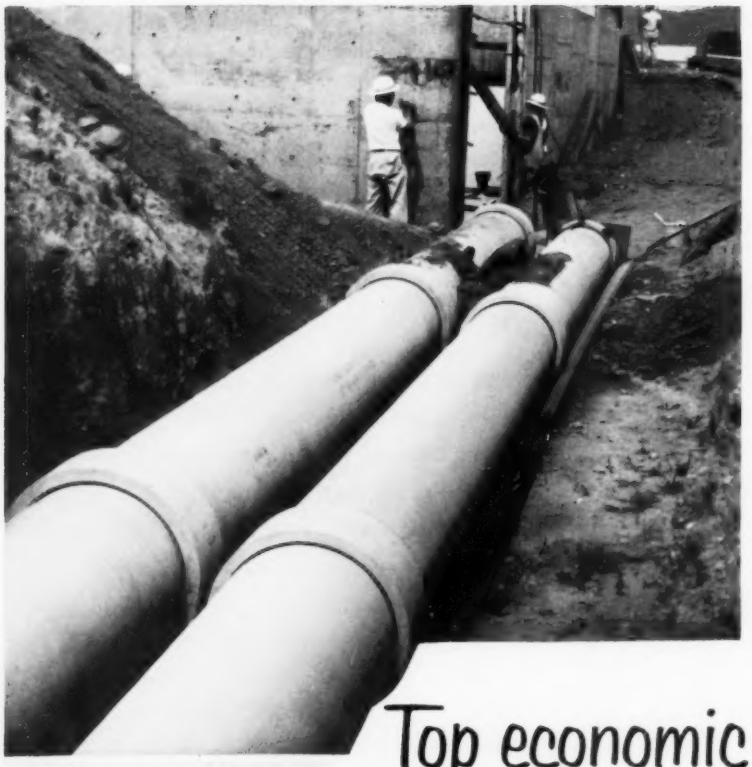

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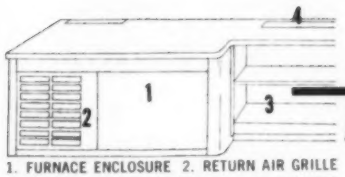

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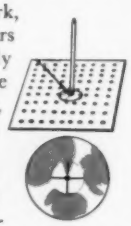
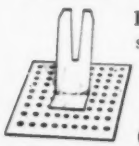


GEMCO Pronged Hangers



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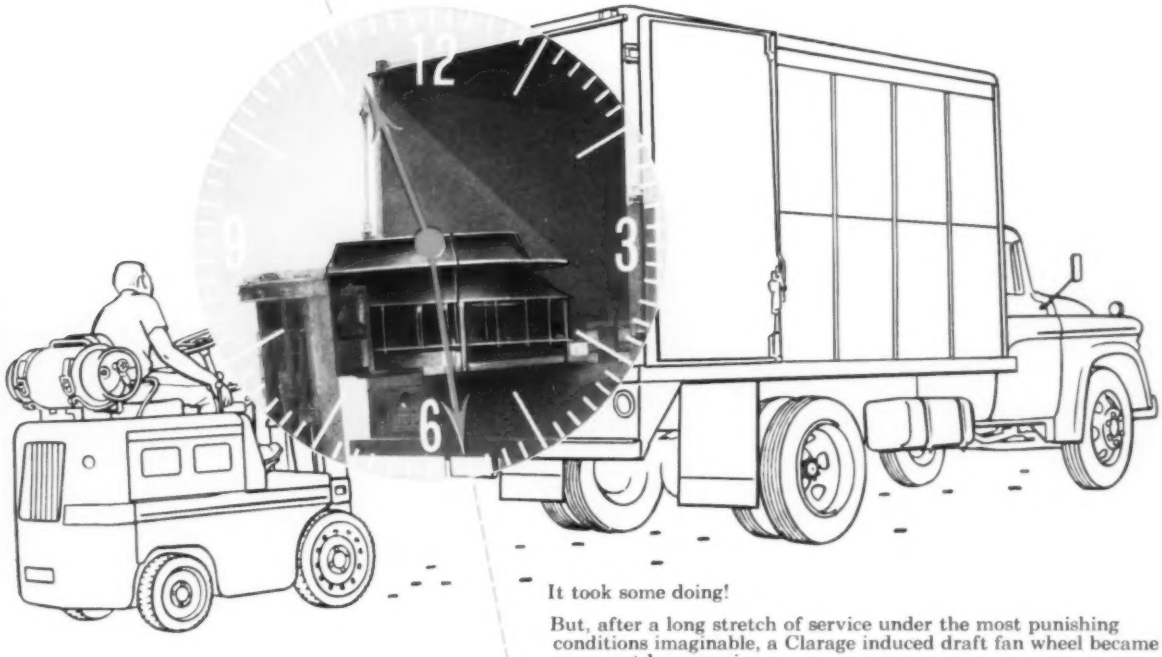

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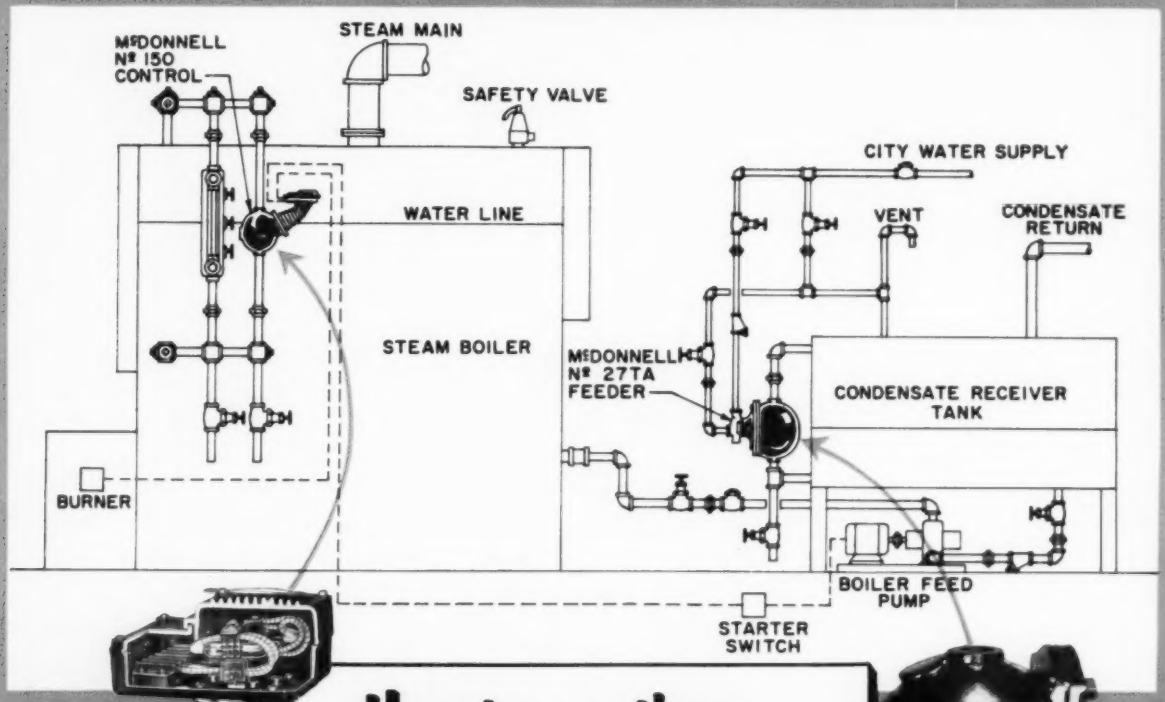

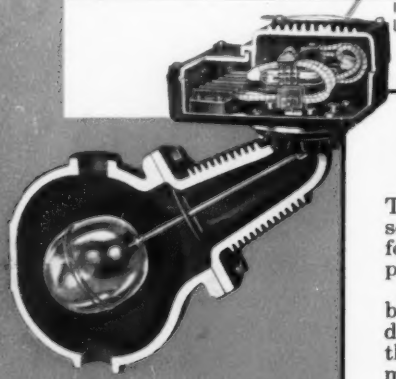

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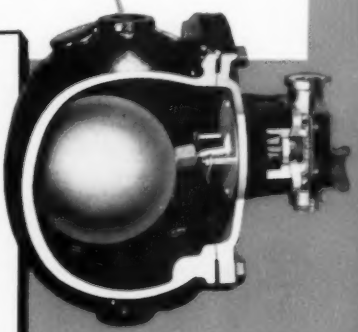

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BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS